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Marine Terminal Equipment

In devoting this issue to the subject of marine terminals we have taken up only that phase of the subject which applies to the economical handling of miscellaneous freight. Considering the slow and expensive methods of loading and discharging vessels that prevail in most American seaports, and the resulting congestion and delays that occur in handling shipments, the importance of the subject at once becomes manifest. In general, European ports are extensively equipped with freight-handling machinery designed to lower the cost of handling freight and to decrease the time vessels are required to remain in port for receiving and discharging cargoes. The methods adopted in European ports, however, have been developed to meet existing conditions, and in most cases cannot be applied directly to the conditions existing in the average American seaport. The physical characteristics of harbors and the local conditions prevailing in transportation systems must first be considered before determining the most desirable and most economical equipment for a marine terminal. In every case, however, the solution will be found in the application of some form of machinery to supersede manual labor.

Western River Terminals

At no place in the United States has progress in the development of marine terminals been so retarded as on the Western rivers, where in recent years the once prosperous steamboat packet business has dwindled to an insignificant amount. In accordance with the customs handed down from the days before the Government improvement of the rivers was begun, the sloping bank of the river at any convenient place still constitutes a steamboat landing, except in the large cities where paved levees and floating wharves are used. That merchants and city officials are awakening to the fact that the only way in which the river steamboat traffic can be successfully fostered is by the establishment of adequate terminals at the large cities along the rivers, with suitable railroad connections, is shown by the river terminal conference which was held recently in St. Louis. The conference has now become a permanent organization to encourage the development of adequate terminals along the Mississippi, Missouri and Ohio rivers, and there is every prospect that material results will accrue from the plans and suggestions discussed at the conference. As pointed out in a paper read before the conference by H. McL. Harding, speed in loading and discharging freight and the reduction of time of detention of the vessels are the chief factors in the successful operation of a marine terminal and for river terminals the type of machinery best adapted for rapid and economical handling of freight is some form of vertical hoist installed on quay walls, so that the freight can be hoisted directly from the barge and conveyed to the terminal shed or warehouse.

Award of Prizes in Engineers' Contest

The first prize in the contest for the best letters sent to this journal before January 1 by practical marine engineers has been awarded to Lieutenant G. J. Meyers, chief engineer of the United States battleship *Rhode Island*, for a letter on "Economy of Coal and Boiler Corrosion." D. Sawyer, chief engineer of the steamer *Northland*, of the Norfolk & Washington Steamboat Company, Norfolk, Va., has been awarded the second prize for a letter describing an interesting change in a twin screw steamer, and Joseph Church, 2d, of Tiverton, R. I., has been awarded the third prize for a letter which relates his experiences with a keel condenser. The prize-winning letters will be published in our next issue, and these will be followed in later issues by other letters submitted in the contest which are considered of sufficient interest for publication.

Prospects Bright for Shipbuilders

Since early last December contracts for over fifty steam vessels, most of which are of several thousand tons deadweight capacity, have been placed with American shipbuilders, and inquiries are out for from fifty to sixty additional ships. The prediction made in our January issue, that favorable conditions would prevail in the American shipyards during the coming year, has been fully borne out, and the outlook, especially in the shipyards on the Atlantic coast, is better than it has been for many years. While the Atlantic yards are rapidly filling up to full capacity, the yards on the Pacific coast are also beginning to feel the stimulus of increased busi-

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ness, and it is probable that in a short time an increased number of orders will be placed in these yards. As compared with the period covered by the last six months of 1914, when scarcely an order of any consequence was placed in an American shipyard, the outlook is most promising. Practically the only district that will not benefit directly by the increased demand for American-built ships is the Great Lakes, where the over-production of tonnage in recent years has reduced the demand for new vessels to barely enough to keep one or two yards engaged to even moderate capacity.

Retirement Allowance for Shipyard Employees

The Newport News Shipbuilding & Dry Dock Company has instituted a system of retirement allowances for its employees that should benefit greatly not only the employees at the yard, but also the company itself. All employees of the company are eligible to receive the retirement allowance in accordance with the rules and regulations prescribed by the company. The allowances are voluntary gifts on the part of the company, and the continuance of their payment depends upon the earnings of the company, and of course may at any time be reduced, suspended or discontinued, if it is found necessary to do so.

The allowances are granted by a special board consisting of the general manager of the yard and two other members appointed by him. All allowances granted under this plan are unassignable, and they are paid only to those employees who have given their entire time to the service of the company. Retired employees, however, are held to be no longer in the employ of the company and are at liberty to engage in other business. The payment of the allowance, however, will be discontinued if the business engaged in is considered prejudicial to the interests of the company.

The amount of the retirement allowance is based on length of service. For each year of service with the company the allowance will be one percent of the average yearly pay received during the last ten years of service, the amounts being paid in monthly installments. The length of service on which the allowance is based is reckoned from the date since which the employee has been continuously in the service of the company to the date when retired.

Subject to the rules prescribed by the company, retirement allowances will be given to (1) men who have been twenty-five years or longer in the service of the company and who have reached the age of sixty-five years, (2) women who have been twenty years or longer in the service of the company and who have reached the age of fifty-five years, (3) men who have been in the service of the company thirty years and who have reached the age of sixty years, and (4) women who have been in the service of the company thirty years and who have reached the age of fifty years. Retirement of employees, with allowance, when the specified length of service has been reached, is optional with the employee or with the company, although employees in executive or administrative positions may be allowed to remain in active service after reaching the ages specified for retirement.

Nationality of Vessels Carrying American Commerce

According to a recent statement made by the Secretary of Commerce, the aggregate value of the water-borne commerce of the United States, including imports and exports, in the fiscal year ended June 30, 1914, amounted to $3,785,469,000 (£776,000,000). Of this, 53.45 percent was carried in British vessels, 13.79 percent in German vessels, 9.26 percent in American vessels, and the remainder in smaller percentages in vessels of other nationalities. From July to December, 1914, the total value of the water-borne commerce was $1,660,761,000 (£341,000,000), of which 52.54 percent was carried in British vessels, 14.09 percent in American vessels, 6.03 in Norwegian vessels, and the remainder in smaller percentages in vessels of other nationalities. Again, for the month of December, 1914, the value of the water-borne commerce of the United States amounted to $323,234,000 (£66,300,000), and of this 53.1 percent was carried in British vessels and 11.5 percent in American vessels. While the percentage of imports and exports of the United States carried in American vessels is gradually increasing, it by no means represents the gains which should be made under existing conditions if the United States possessed an adequate merchant marine for foreign commerce.

International Engineering Congress

From two hundred to two hundred and fifty papers and reports, covering all phases of engineering work and contributed by authors representing some eighteen different countries, have been assured for the forthcoming International Engineering Congress to be held September 20-25 in connection with the Panama-Pacific Exposition at San Francisco, Cal. In spite of the fact that the number of representatives from the countries involved in the European war will naturally be less than originally planned, the Congress, nevertheless, will be thoroughly international in scope and character. According to a report from the Secretary of the Congress, the papers are now rapidly coming in, and their character gives full assurance that the proceedings will form a most important collection of engineering data and a broad and detailed review of the progress of engineering art during the past decade. Invitations are now being issued by the Committee of Management to all important engineering societies of this country and abroad to appoint official delegates to attend the sessions of the Congress, and the presence of a considerable body of such delegates is well assured. Membership in the congress with the privilege of purchasing any or all of the volumes of the Proceedings is open to all interested in engineering work.

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The Classification of American Ships

In his annual report for the year 1914 the Commissioner of Navigation gives a list of the steel vessels of 1,000 gross tons and over built in the United States and documented during the year ending June 30, 1914. This list comprises a total of 29 steel steamers aggregating 133,234 gross tons. Five of these vessels were ferry-boats and the remaining twenty-four included several oil tank steamers, two vessels for service in Chesapeake Bay, two Long Island Sound steamers, several American-Hawaiian vessels and three Grace steamships, while the balance were lumber, coal and freight steamships. Of these twenty-four ships nineteen aggregating 104,950 gross tons were classed by Lloyd's, and so far as we have been able to discover, only three, aggregating 13,369 gross tons, or about 10 percent of the total, were classed by other societies.

Further on in the report the Commissioner gives the names of the steel vessels building or contracted for on July 1, 1914. This list includes fourteen vessels, among which are a number of oil tankers, the two large passenger steamships *Great Northern* and *Northern Pacific*, and three or four colliers and freighters. Eliminating two ships that we understand are not classed at all, there remain twelve ships aggregating 96,880 gross tons building or contracted for on July 1, 1914. Of this tonnage, ten aggregating 77,580 gross tons were classified by Lloyd's and one by another classification society. The classification of the twelfth ship has not been disclosed. It will be noticed, therefore, that of the steel steamships, either building or contracted for on July 1, 1914, not one was classed by an American society.

From the foregoing facts it is very evident that the classification rules of the American ship classification society do not appeal to ship owners. It is not for us to decide where the trouble lies, but we do feel that it is necessary for us to call the attention of the marine interests of the United States to this apparent reflection upon American engineering ability, and we feel sure that our readers will agree with us that the services of American societies should be made suited to the uses of the ship owners of the United States, so that American-built and American-owned vessels need be classified only by an American classification society.

The Need of a Federal Law for Safe Ship Construction

The question of classing vessels leads up to another very important question, and that is, the legal protection of the lives of passengers and crews on vessels. So far as any federal law in the United States is concerned, we understand that there is no protection. Indeed, a man can build the flimsiest kind of a vessel, so far as interference by the federal authorities is concerned, provided he can find a shipbuilder who is willing to construct a vessel of that kind. Fortunately, there is probably not a builder in the country that would deliberately consider building a vessel that he did not regard as seaworthy. That, however, is because of regard for his own personal reputation and the reputation of his company rather than because of any law on the subject. Furthermore, if a man were to succeed in having a flimsy and unseaworthy ship built, he could not secure insurance except at a prohibitive price, if even at any price, so that again public sentiment and public appreciation of the eternal fitness of things takes the place of federal law. The recent International Congress in London, which discussed the question of safety at sea, took advanced grounds on the designing and building of ships. It seems as though it is the duty of the United States Government to pass laws requiring that ships be built which shall be constructed along the lines laid down in the report of this Conference, an abstract of which was published in our issue of May, 1914. The time has passed when any chances should be taken with the lives of either passengers or crew, and it ought to be the duty of the federal government to have laws put on the statute books at the earliest date possible requiring every ship to be so constructed as to give the maximum of safety.

One Advantage of a Naval Reserve

The conditions in the shipping field will be very radically changed by the present war. Even before the war broke out it was difficult to find enough sailors in Great Britain to man the ships, and even the Germans were unable to furnish all the men called for. For several years past it has been the policy on the British ships to replace British and other seamen with Lascars and other Orientals, who work for very low wages and who, to use a common sea expression, "Can live on the smell of an oily rag." Merchant ships that have depended upon labor of this kind have had only a few white men on board, and these were the officers and the engine room force. During the war hundreds of thousands of men will be either killed or incapacitated for working on board ship, so that when peace is declared there will be a greater demand than ever for seamen, and apparently they will to a very great extent come from the Orient. Something ought to be done in the United States to prepare for this condition. Years ago it was the ambition of the energetic young men on Cape Cod and the coast of Maine and other parts of the country to ship before the mast and work up from the forecastle to the cabin so as to become masters of ships. All this has been changed by the introduction of so many foreign elements in the forecastle, and, as the result, there is no practical training for men who serve in the merchant marine outside of the training on our school-ships. It is for this reason that Congress should include in any shipping bill a clause establishing a special naval reserve and offering inducements in the way of extra pay for all men on board ships entering the foreign trade who are American citizens to join this naval reserve.

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Transfer Facilities at Marine Terminals

Plans and Designs for Equipment for Economical Loading and Discharging of Vessels at Marine Terminals

BY H. MC L. HARDING *

At marine terminals the most important feature of operating conditions is to secure the utmost speed of discharging and loading the vessels. After this comes economy, which, however, is often sacrificed by the employment of many men, chiefly in handling, to obtain this desired rapidity. These two features can only be secured by correctly planning the terminal with this end in view.

To produce successful results, it is essential that there should be a personal knowledge of what has been successfully accomplished elsewhere, particularly at foreign continental ports, with special reference to the specifications,

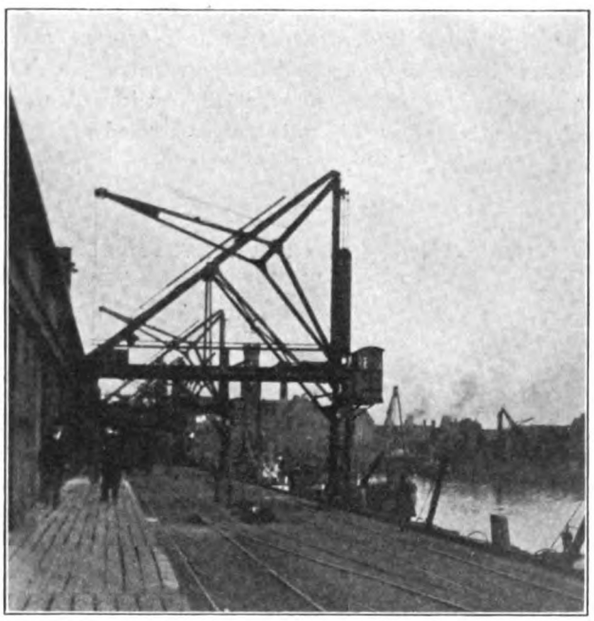

Fig. 1.— Traveling Jib Cranes Spanning Quay Wall Along River Weser at Bremen, Germany, for Transferring Freight to Distributing Shed or Cars, and the Reverse Movement

and to the guarantees of performance required by port authorities from the foreign manufacturers. It is difficult to obtain this information by reading, as in the little available literature much is obscured. To this must be added an acquaintance with the best American operating conditions which is possessed by many transportation superintendents and foremen. Unless there is this knowledge of foreign terminal conditions, of foreign package freight transferring and handling machinery, combined with an acquaintance with the operating methods in the United States, it is difficult to obtain speed and economy without congestion. To this lack of knowledge and experience has been due the unsatisfactory freight handling at terminals in this country. Marine terminal engineering should be founded upon world-wide knowledge and should not be provincial.

Definitions

Transference.—The direct movement between the vessel and the shore, in either direction, may be termed cargo-transference, and with this may be combined assorting.

Handling.—The freight movements in the vessel, or, upon the pier or within the shed, may be designated as "cargo handling." The handling movements may be divided into assorting, distributing and tiering, according to consignments. In the discharging movement for foreign commerce, the cargoes are generally lifted vertically by the ship's winch or by traveling gantry jib cranes.

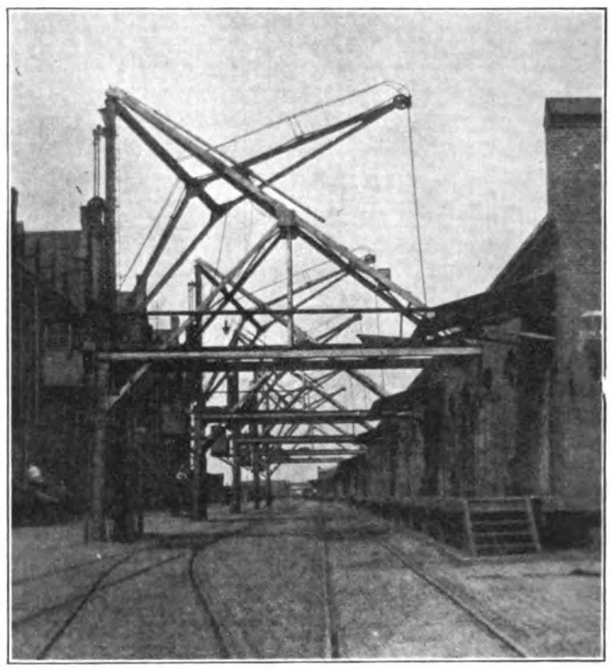

Fig. 2.—Rear of Distributing Shed, Showing Cranes for Transferring Freight by Direct Movement to Long-Storage Warehouse, Cars, Drays or Motor Trucks

Methods.—The fall rope of the winch is attached to a first boom, from the hook of which the draft is transferred by burtoning to the fall rope of a second boom and by it lowered to the side of the pier, whereby two drafts are in transference at the same time. The movement from the hold of the vessel to the pier is practically continuous.

In some cases the draft is burtoned to a fall rope suspended from the roof of the shed, attached to a second winch located within the shed or upon the pier, or else burtoned to the hook of a gantry jib crane or to the hook of an overhead traveling electric hoist.

Mechanical Transference Costs

If the gantry jib crane by itself raises the load from the vessel's hold, and deposits it upon the pier, or burtons it to hook of the traveling hoists, the cost of the mechanical movement of transference only, not including handling either within the ship or on the shore, with full loads, may be taken as averaging about three cents (0/1½) per ton.

If the transference be by one winch on the ship and another winch on the shore the cost will be increased to

* Consulting Engineer on Marine Terminals, New York City.

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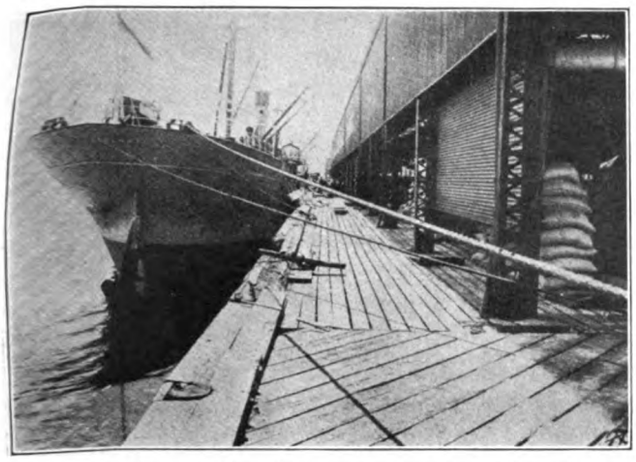

Fig. 3.—Typical Waterfront at New Orleans. Note Absence of Railway Tracks, Necessitating Trucking of Freight a Distance of 100 to 200 Feet to Railway Cars. Outbound Cargoes, Instead of Being Swung by One Movement from Car to Vessel at a Cost Between 3 and 6 Cents (0/1½ and 0/3) per Ton, Cost Between 25 and 35 Cents (1/0½ and 1/5½) per Ton or More for Handling. For Loading 1000 Tons of Freight this Represents an Unnecessary Cost of $3,000 (£616). The Condition of the Wharf, and Especially of the Decayed String Piece, Is Noticeable and Should Be Compared with the Concrete Quay Walls Illustrated in this Article

between five and six cents (0/2½ and 0/3) per ton, there being two winch crews.

If one mark only is raised at a draft, by which is accomplished the assorting, the above figures of three cents and six cents (0/1½ and 0/3) may each be doubled, respectively, to six cents and twelve cents (0/3 and 0/6).

As the gantry jib crane can serve a greater area, and prevent congestion at the place of deposition by serving a greater area than is possible by the ship winches, data will be given concerning the performance of these gantry cranes.

Crane Transferring Capacity

Were it not for the hoisting of drafts of only one consignment, by which assorting is done, then from five hatches of a freighter with two cranes at each hatch, and with full loads, it would be possible to transfer 640 to 800 tons per hour. As most outbound freight from port to port requires no assorting, full transferring capacity can be attained.

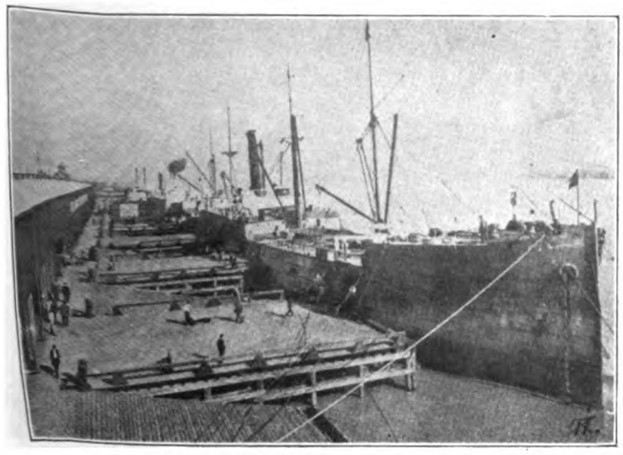

Fig. 4.—Unloading Vessel at New Orleans. Cargo Moved by Manual Labor Up Inclined Aprons

Assorting

On account of transferring only one mark or consignment in each draft, thereby accomplishing the assorting, there would average 400 tons per hour, this lesser amount being due to the average lighter loads. It is, therefore, possible to transfer mechanically between vessel and shore between 640 and 400 tons per hour at a cost from three to ten cents (0/1½ to 0/5) per ton for the movements of transference by machinery. If assorting is done after transference, the cost for assorting alone will average from thirteen to sixteen cents (0/6½ to 0/8) a ton.

The handling or the second movements of distributing and tiering, the assorting having been accomplished, can be done best by machinery.

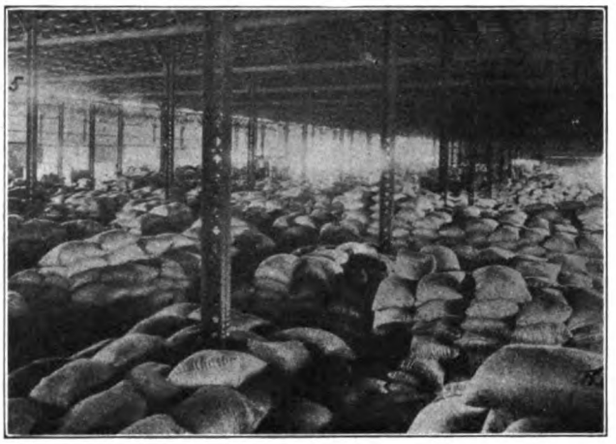

Fig. 5.—Steel Shed Filled (?) Only 5 Feet High Indicates Lack of Co-Ordination Between Vessel and Car. Cargo Deposited on Quay by Ship's Boom Must Be Trucked Through One and Sometimes Two Sheds to the Railway Cars

Manual Labor Costs

The cost for manual labor for distributing and tiering will be from twenty-nine to thirty-six cents (1/2½ to 1/6) per ton, including the handling in the hold. This variation, as in other cases, is due to the character of the cargo and the number of marks.

Mechanical Handling Costs

By mechanical handling by overhead traveling hoists for distribution and tiering, and the use of motor trucks for longitudinal distances, the cost can be reduced to twelve to fifteen cents (0/6 to 0/7½) per ton.

Through Overall Hatches

The vertical movement, as lifting, in regard to speed and economy, is of more importance than horizontal floor movement. This 640 to 400 tons per hour, through the overall hatchways, at a total cost from fifteen to twenty cents (0/7½ to 0/10) per ton can only be attained, as already stated, by correct planning.

Side Port Transference

With domestic commerce, carried largely by coastwise steamships, there has grown up the idea that speed and economy have been secured by transferring the freight by manual labor through side ports, or that in any event there is greater speed.

The origin of this practice was largely due to the passengers and freight being combined in the same vessel. As many large overall hatchways would interfere

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with stateroom and saloon space, the side port transference was evolved.

As to the question of speed and economy the following is quoted from a report of the United States Government (House Document) prepared under the direction of the War Department:

"Along the Mississippi River, at the harbor of New Orleans, there is allotted to one steamship company a lineal berthing frontage of 2,100 feet extending from Dumaine to Conti streets, capable of accommodating four 450-foot vessels.

"There is a total of 209,680 square feet with sheds 141 or 80 feet in width.

"For the year 1912 the tonnage transferred and handled was 581,172 tons.

"The average cost through side ports for the year 1910 was 54.85 cents (2/3.4) per ton of 2,000 pounds on a basis of thirty cents (1/3) per hour for manual labor. Forty cents (1/8) per hour is paid for night and Sunday labor. The average time of loading and discharging is 125 tons per hour."

The utmost expedition is illustrated by citing the particular case of one steamship which was docked at 8:30 A. M., Jan. 25, 1913, and discharged through side ports 1,725 tons in eleven and one-half working hours, or an average of about 150 tons per hour, employing 355 men. This service included assorting, distributing and piling (tiering) in the sheds. The vessel was loaded with 2,831 tons in twenty-one and one-half working hours, or an average of 131 tons per hour, employing 200 men. The cargo consisted of miscellaneous package freight, and five ramps were used. The cost per ton was seventy cents (2/11) in this instance.

The average tonnage per lineal foot per year was 276.75 tons, which is excellent for manual labor. The following are lineal foot tonnage transferences per year for several foreign cities:

Bordeaux, 447 tons; Havre, 476 tons, and Marseilles, 564 tons.

The figures from New Orleans should be compared with figures of the official tests made by the port authorities of Montevideo, Argentine Republic, South America, as to hourly transferring capacity. The tests were made to decide as to the purchase of additional traveling gantry cranes.

These figures represented such satisfactory working of twenty traveling gantry jib cranes that an additional order was given for thirteen more cranes for the same harbor.

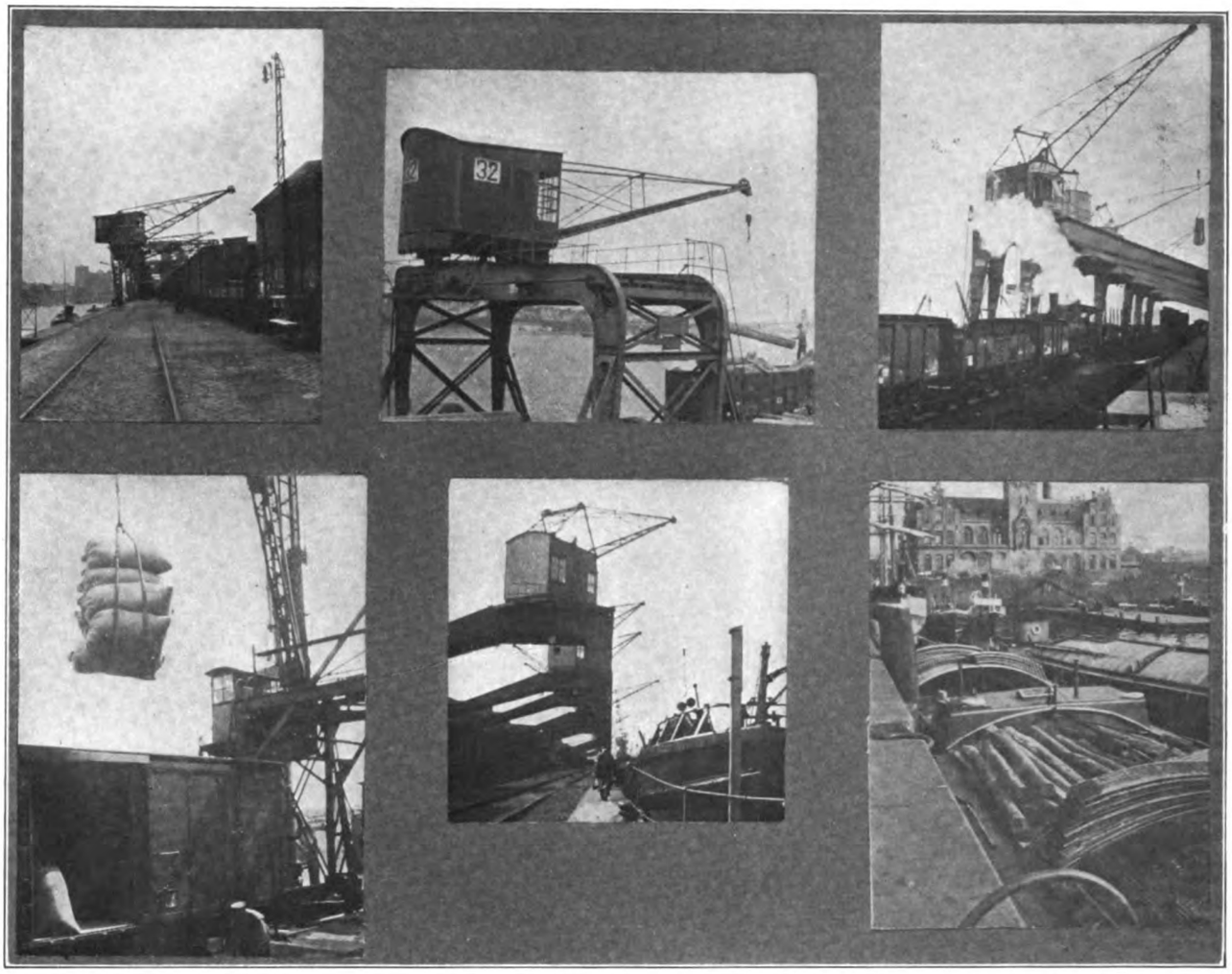

Fig. 5.—Views of Various Types of Full Arch and Half Arch Traveling Gantry Cranes Operating on Concrete Quay Walls Transferring Miscellaneous Freight Between Vessels and Cars or Shed

COSTS OF TRANSFERRING FREIGHT AT MONTEVIDEO

Capacity of cranes, 5,000 Kg = 11,025 pounds; lifting speed at full load = 24 meters = 79 feet per minute; revolving 1½ times per minute, equal to 130 feet at the hook.

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The current consumption is figured for a cycle, consisting of the following movements:

Lifting 11,025 pounds out of the vessel 25.5 feet, revolving the crane through 120 degrees, lowering the load to the wharf, lifting the empty hook, revolving the crane 120 degrees to its original position and lowering the hook to the position from which it started. This was repeated a large number of times to get the average time per cycle.

The consumption of current at 500 volts D. C. was found to be 250 watt hours. At a cost of the current of three cents (0.1½) per kilowatt hour, the cost of moving 11,025 pounds through the above-mentioned cycle would be $250 \times 3 = 75$ cents (3.1½), or $\frac{2{,}000 \times .75}{11025} = .14$ cents (0.0.07) per ton of 2,000 pounds.

The time for one cycle was 70 seconds, to which 20 seconds were added for attaching and detaching the load, therefore the crane made 40 cycles per hour, making an output of $5 \times 40 \frac{2{,}205}{2{,}000} = 220$ tons per hour of 2,000 pounds for one crane. That with ten cranes would be 2,200 tons per hour.

These are official tests and guaranteed by the manufacturers. Instead of five-ton cranes, of which thirty-three of this type were installed at Montevideo, it is preferred to use two-ton cranes, with a reserve capacity and with the load of two tons at 160 to 180 feet per minute. Twenty-five hundred to 3,000 pounds at 180 to 240 feet per minute are common, and in the latest examples at Marseilles there were 300 feet per minute. It will be noticed that two tons at 180 feet per minute would approximate four tons at 79 feet per minute. The 640 tons per hour, as given, is, in comparison with the possible 2,200 tons per hour, conservative; and yet how great the 640 tons per hour, through the overall hatches, is to the maximum 150 tons per hour through the side ports, in the Federal Government Report as to New Orleans!

The three cents (0.1½) per ton is divided approximately into one cent (0.0½) for current, one cent (0.0½) for labor and one cent (0.0½) for amortization, interest and maintenance.

The above indicates most liberal figures for transference and are applied to the conditions in the United States. The total cost of mechanical transferring and mechanical handling through overall ports may be taken on the average from twelve to fifteen cents (0.6 to 0.7½) per ton, as compared with twenty-nine to thirty-six cents (1/2½ to 1/6) per ton by manual labor through overall ports, and with forty-five to fifty-five cents (1/10½ to 2/3½) per ton through side ports by manual labor.

Movement of Cargo to Warehouse

There is another movement of a portion of the cargo, viz., to the warehouse for long storage. If the inbound cargo be not removed from the pier or quay shed after forty-eight or seventy-two hours of free holding, it is then removed to the warehouse for long storage, the expense for moving and storage being at the expense of the shipper or consignee. There are, in addition, transference to other vessels, to cars and drays, both in loading and unloading. To obtain the figures given above of transferring and handling capacity and the costs, the plan of the terminal and the design and adaptation of the machinery are all important.

To illustrate one form of layout used extensively and efficiently on quays abroad, the accompanying illustrations are reproduced from photographs taken by the author: Figs. 1 and 2 show the quay, the shed and the warehouse of a foreign installation. Terminals in the United States, if equipped with the latest electric cranes and overhead traveling hoists, adapted to American operating conditions, both for transferring and handling, will fulfill the exacting conditions of speed and economy of package freight handling.

Fig. 1, taken on the Weser River, shows a concrete and stone quay wall, upon which is one crane rail, a half arch traveling gantry jib crane with its other supporting rail attached to the front of the shed, two railway tracks, and the front of the handling shed. The crane is hydraulic, but according to the latest practice, electric cranes are preferred to hydraulic. To obtain a better supervision of the hoisting and conveying movements the cab is now placed up in the jib members and moves with the jib of the crane. In many cases electric quay capstans are used for moving cars and vessels.

The platform in front of the shed, raised to the level of the railroad car floor with the shed floor at the same level, would be suitable if cranes alone are to be employed. The platform, however, would prove a barrier if the two-wheeled hand trucks or the small four-wheeled motor trucks should be used. It is preferable to have no raised platform, and the shed floor to be only a few inches above the level of the quay.

On account of the increasing use of the large motor trucks, in the place of horse drays and even railway cars, the space between the shed and the quay wall should be paved and the railway tracks should be flush with the surface of the pavement.

Fig. 2 shows the rear of the same shed, the to-be-discarded platform, the two railway tracks, which are here even with the surface of the pavement and the roadway for drays or motor trucks which can traverse any portion of the way between the shed and the warehouse.

It will be noticed that the half-arch hydraulic cranes are here not movable, possibly due to the difficulty of obtaining easy water connections with moving cranes. The number of cranes is more than would be required if the traveling electric cranes had been installed—probably double.

These cranes are of the half-arch gantry type of from two to three tons. The full-arch traveling jib cranes are preferable here, as such cranes can travel by their own power to other places on the quay where there are no sheds and where it is desired to transfer bulk material or single commodities not affected by climatic conditions.

Behind the roadway are the warehouses, which, though built for and used only for warehousing, have an impressive and pleasing architectural effect.

Inbound Cargo Movements

From the ocean steamship, from the barge or Rhine-boat, by means of the cranes, the drafts are raised and swung to the car or to the floor of the shed or upon a platform extending out from the front of the shed. If it is necessary to distribute according to consignments and then ship, this distribution is done within the shed and delivered to the cars located at the rear or in some cases in front of the shed. After the designated time (it may be forty-eight or seventy-two hours) the freight is swung by one movement of the crane from the shed to the platforms in front of any floor of the warehouse.

Outbound freight, generally not requiring assorting, is swung directly from the cars into the hold of the vessel by the cranes, or, if in the shed, similarly from the shed to the vessel.

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CONCLUSIONS

First.—In the plan of a similar terminal, the salient features are the nearly vertical quay walls, the quay with its railway tracks and cranes, then the shed mechanically equipped and directly behind the shed the railway tracks, the roadway, the cranes and the warehouses.

Second.—The length of the shed should be about the same as that of the largest freighter, its width such that it will have a holding capacity with high tiering for the full inbound and outbound cargo of such a freighter.

Third.—On a projecting pier the shed should be in the center of the pier with ample space between the shed and the pier wall on each side.

Fourth.—The warehouses should be upon the shore and from four to six stories in height.

Fifth.—Unless a marine terminal is planned and designed for the installation of mechanical appliances, it will be almost impossible to secure the maximum mechanical efficiency.

Sixth.—By equipping a correctly planned terminal with properly designed mechanical appliances, the utilization of the whole terminal can be at least doubled.

Electric Trucking at the New York Terminal of the Southern Pacific Steamship Company

Savings of 78 percent in the cost of labor in transferring freight a distance of 1,000 feet on the Southern Pacific piers in New York were effected by the substitution of electric storage battery trucks for the hand trucks formerly used. Eighteen electric trucks were installed on these piers a year ago and now form a permanent part of the freight handling apparatus at this terminal.

Fig. 1.—Electric Trucks Handling Freight at Southern Pacific Piers

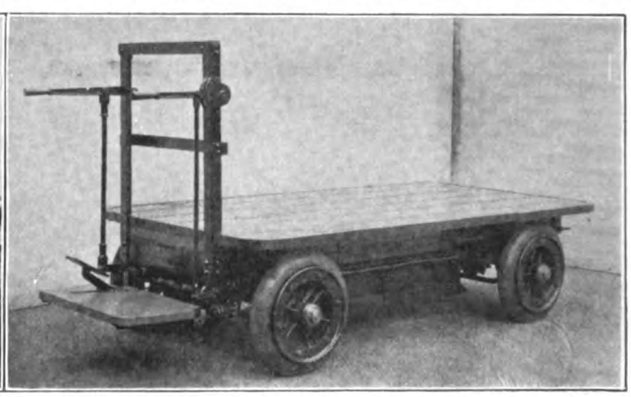

Fig. 2.—"Hunt" Two-Ton Electric Storage Battery Truck

The requirements at the Southern Pacific New York terminal are unlike those at many other steamship piers, in that the waterfront holdings of the Southern Pacific Steamship Company embody four piers, each 750 feet long by 125 feet wide with a total street frontage or "farm" 1,490 feet long by 50 feet wide, the latter area being used for the temporary storage of barrels of oil, rosin and molasses. The round-trip distances that a truck must make between the ship and the "farm" averages between 1,500 and 2,000 feet, and the distances from the ship to different points within the various pier sheds vary from 200 to 1,000 feet. The trucks are subject to rough service and are operated by longshoremen.

The truck installed is a two-ton capacity "Hunt" truck, manufactured by C. W. Hunt & Co., Inc., New Brighton, N. Y., having a clear platform of 4 by 7½ feet, or large enough to hold six barrels on end with strength sufficient to carry 100 percent overloads when occasion demands. The trucks have a speed range of from 1½ to 10 miles per hour. In brief, the two-ton "Hunt" truck can carry ten times the average load at four times the speed of a hand truck.

The following data compiled on actual operating costs give some indication of the vast improvement which has been made by the adoption of this method of handling freight at this terminal. The operating record established at the Southern Pacific pier No. 49 consisted of carrying 3,700 barrels of oil and rosin (400 of rosin) from pier 49 to the "farm," a round-trip distance of 2,000 feet per load in a total working time of 10 hours, employing 22 men; 12 men loading, 6 men operating trucks and 4 men unloading. The labor cost per ton amounted to .0775, as compared with .354 per ton for hand trucking, making a saving of .276 per ton, or 78 percent.

The trucks were loaded by sliding the barrels on skidways direct from the ship to the truck, and they were unloaded by rolling the barrels off on skids. Each truck carried 616 barrels, or a total weight of 142 tons, a distance of 39 miles in 10 hours. Each truck weighs 2,200 pounds, the battery consisting of 36 A-4 Edison cells of 160 amperes. The trucks were charged for one hour at noon.

ANNUAL MEETING OF THE INSTITUTION OF NAVAL ARCHITECTS.—The annual meeting of the Institution of Naval Architects will be held on March 24 and 25 in the Hall of the Royal Society of Arts, John street, Adelphi, London, W. C. Owing to the continuance of the war, the customary entertainments will be omitted.

MONTHLY SHIPBUILDING REPORT.—The Bureau of Navigation, Department of Commerce, reports 32 sailing, steam and unrigged vessels of 12,258 gross tons built and officially numbered in the United States during the month of January. Four of these vessels, aggregating 9,033 gross tons, were steel steamships, the largest being the *Northern Pacific*, built by the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., for the Spokane, Portland & Seattle Railroad Company.

CORRECTION.—On page 94 of our February issue the name of the inventor of patent 1,116,724 is erroneously given as Frank Nicholas. This should read as Frank Nichols, of Munroe, New York.

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Freight Handling at Railway Marine Terminals

BY C. A. HARDY *

In an article contributed by the writer to this magazine a year ago, the design of a warehouse and dock in combination with traveling cranes inside and gantry cranes outside was shown. Since the previous article was published, railway and steamship men have suggested certain changes which are embodied in the sketch shown herewith.

It appears that many steamship lines only accept freight which can be handled by the ship's hoisting machinery. The ships are arranged so that the crew handle the freight in and out of the vessel, taking it from the wharf and depositing it in the hold of the ship, and when arriving at the destination, taking it from the hold and laying it on the wharf alongside.

Wherever this arrangement prevails it is advisable that the booms of the cranes and the legs of the gantry cranes on the wharf shall be set back from the edge of the wharf so that there is no possible danger of interference with the rigging of the ship during docking, or with the ship's derricks in loading and unloading. This arrangement is shown in the sketch.

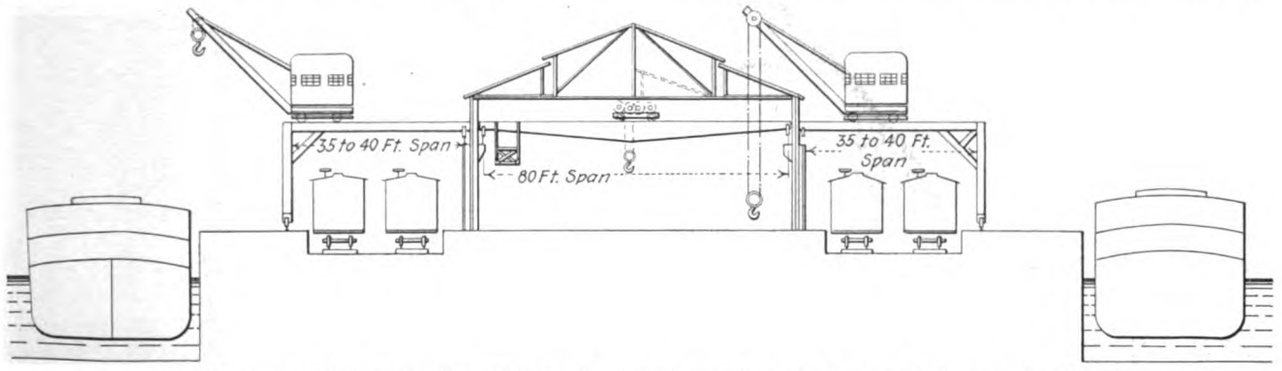
Railroad engineers have also suggested that the handling of freight can be greatly expedited by depressing the tracks to the level of the floor of the warehouse and the level of the wharf alongside. This practice is regularly followed in all the large freight terminals, and with this arrangement the package freight arriving in box cars can be easily trucked from the cars to the wharf and there picked up by the ship's derrick. Small package freight, placed by the ship on the wharf, can be trucked into cars for reshipment, without the use of the crane; and where merchandise arrives in box cars which is to be stored in the warehouse pending the arrival of the steamer this arrangement facilitates the handling of it materially.

By a suitable arrangement of bridges, which can be arranged to be operated electrically, package freight can be trucked back and forth from warehouse to ship, or from wharf to warehouse. With this arrangement electric storage battery trucks can be brought to the side of the ship and small package freight delivered therefrom directly to the ship's derrick without another handling. Freight taken from the hold of the ship can be dropped on these trucks, thus doing away with one handling. The storage battery trucks can then take the freight from the warehouse, the depressed tracks being provided, as stated above, with draw bridges, or drop bridges, at convenient points.

This arrangement also provides a roadway down the side of the wharf over which drays can deliver heavy package freight directly under the ship's cargo boom, thus doing away with another handling. There is no necessity of running teams through the covered portion of the dock. This will appeal strongly to anyone who has visited an old dock where drays and carriages run down the full length inside. The floor of the warehouse can be kept absolutely clean, and many of the disagreeable odors unavoidable where horses are used in a closed building are absolutely avoided.

Heavy package freight or machinery deposited on the dock from the boat, which is not subject to damage by weather, can be allowed to remain for transshipment, or until it is hauled away, and when hauled away the gantry cranes can be used to load it on the trucks.

A further development for the rapid handling of package freight, such as grain in sacks, cotton or other merchandise in bales, such as jute, hemp, etc., where the entire contents of the cargo consists of packages or bales of practically the same size, would be an arrangement of a belt conveyor or moving sidewalk whereby the necessity of trucking from the wharf to the warehouse would be done away with by depositing the packages directly from the ship on the conveyor; this conveyor to be arranged to reverse so that packages to be delivered from pier to ship could be rapidly conveyed to ship's side. A movable arrangement of this kind could be installed on a pier equipped as shown in the sketch, and handled by the gantry cranes.



Arrangement of Steamship Pier, With Overhead and Gantry Traveling Cranes, for Handling Freight

* Whiting Foundry Equipment Company, Harvey, Ill.

Handling Cotton with Electric Freight Trucks at Galveston

The success of the electric industrial truck as a substitute for the hand truck on steamship piers has already been noted in these columns, but the application of the "electric stevedore" to the handling of cotton at the compress may be something new to most of our readers. The Merchants & Planters' Cotton Compress and Warehouse Company, of Galveston, has a plant involving 28 storage compartments, an immense compress room, and 4 classing sheds, the total storage capacity being 100,000 bales. Approximately 300,000 bales are handled through the plant annually. The power trucking test made at this plant was probably the first of its kind.

A general vehicle electric freight truck with a 10-foot platform, manufactured by the General Vehicle Company, Inc., Long Island City, N. Y., was placed in service at

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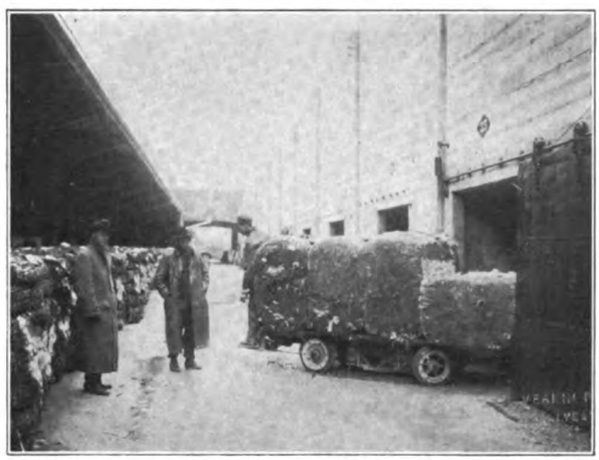
this plant on November 30, 1914, and all that day the truck averaged 25,000 pounds of material in the shape of "flat" bales of cotton per hour, over a 600-foot haul on a shell roadway. That is, over 40 bales of cotton were loaded, hauled 600 feet on shell roads, unloaded, and the truck returned light each trip for every hour of the working day.

"This service represents the work of eight men for the same period of time, using hand trucks," states H. J. Runge, Jr., a local engineer, "therefore cost of handling by 'dragging' would have required eight men for one-third hour at 25 cents (1/0½) per hour, or $2.65 (11/0½). The cost of operating truck is about 50 cents (2/1) per hour. Net saving effected by truck, $2.15



General Vehicle, 10-Foot Industrial Truck, Hauling "Flat" or Uncompressed Cotton from Storage Compartment to Press. Haul About 500 Feet

(8/11½). We expect to be able to show a net saving of $15 (3/2/6) per day through the use of the industrial truck."

When the enormous number of hand trucks in use at even the cotton ports of this country is taken into consideration, the opportunity for economies through the use of these "electric stevedores" becomes apparent and the compactness and flexibility of the elecertic make its use not only possible but advisable in freight terminals and manufacturing plants throughout the country. The use of such trucks is rapidly expanding, there being between two and three thousand already in use.

It has for many years been the aim of the General Vehicle Company to simplify the construction and hence the operation of all its vehicles. The truck has single reduction gearing, doing away with chains, internal gears and universal joints, etc. Self-lubricating roller bearings are used. The controller is enclosed and the automatic cut-off switches minimize accident. One handle is used as controller lever, and the other handle for steering. The controller returns to neutral as the hand is removed from the lever. The cut-off switch cuts off the power when the foot is removed from the brake pedal. In other words, the driver applies the brake simply by releasing the pedal with his foot, and as he releases the pedal the power is cut off automatically. The simplicity of operation does away with the necessity for hiring expensive operators, the average freight handler, colored or white, being taught, it is claimed, to operate the truck successfully, even in congested plants or terminals, in about 24 hours.

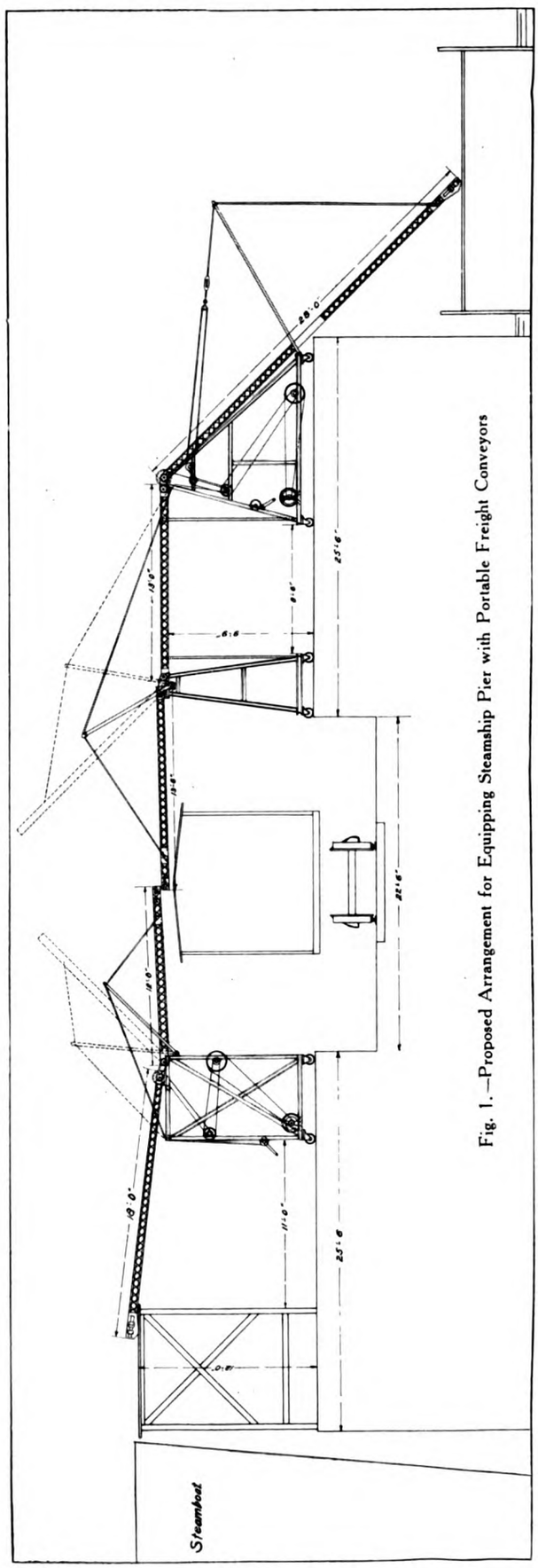


Fig. 1.—Proposed Arrangement for Equipping Steamship Pier with Portable Freight Conveyors

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Unloading Cargoes by Portable Machines

The recent installation of portable and sectional unloading and conveying machinery by the Board of Commissioners of the Port of New Orleans warrants a careful consideration of the economic value of this type of equipment by engineers having charge of the work of unloading large quantities of materials from boats or cars. The problem presented in New Orleans was to cheapen and expedite the work of steamboat discharging and loading up and down a planked 20 percent grade 60 feet long, and delivering the packages to varying heights from the loading of hand trucks to the top of a pile on a motor truck. The problem also included loading and discharging steamships, transferring the freight between shed and deck practically on the level, but providing for the varying heights of decks, due to loading or water level. Further, the machines were to be arranged to be easily moved from one warehouse to another, or to be taken out of the way when not in use. The materials to be handled consisted of bags of rice, flour, coffee, Cuban sugar, cement, bales of cotton, cases of canned goods of various sizes, loose castings and machine parts and casks of molasses, the pieces running in weight from 95 to 700 pounds and varying as greatly in bulk and shape.

Fig. 2.—Conveying Cargo Up 20 Percent Grade by Manual Labor

Fig. 3.—Making Up Sling Load in Ship's Hold

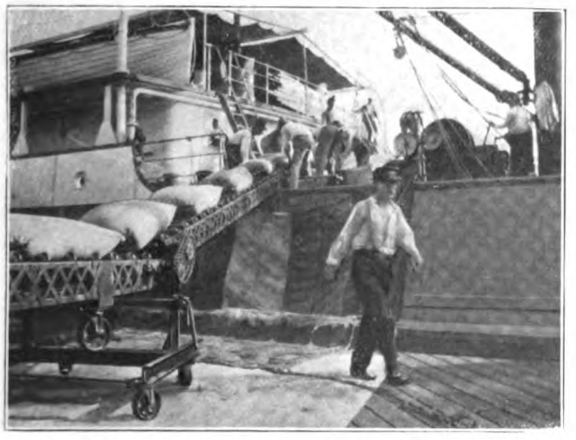

Fig. 4.—Cargo Loaded on Portable Conveyor at Ship's Hatch

The successful installation, made by the Brown Portable Elevator Company, of Chicago, consists essentially of two conveyors, one of the apron type for handling the bags, boxes and loose parts; the other of a "drop-axle" type, for handling the cotton bales and molasses casks. The former is of medium-weight construction and the latter of much heavier construction. The accompanying illustrations show the lighter conveyor; the other differing from this in general appearance only in the heavier type of construction.

It will be seen that the conveyor is made up of a number of sections, supported and connected by platforms, some of which carry the power units. The power is distributed over two, and in the case of the heavier machine, over three electric motors, instead of driving the entire equipment by one motor, as this simplifies the problem of portability. A light, portable crane, shown back of the machine in Fig. 5, is provided, and by using this, one or two men can disconnect all the sections and place them on the ground ready for moving in a few minutes, and

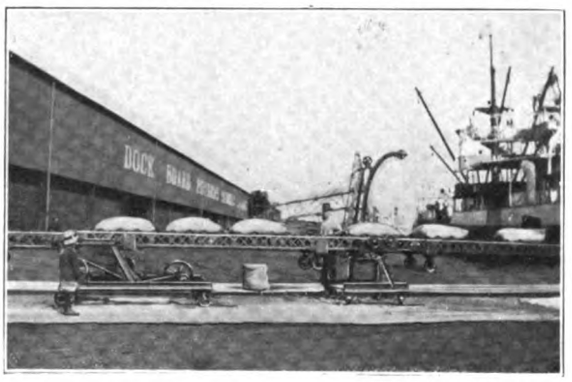

Fig. 5.—Transferring Cargo from Ship to Shed on Portable Conveyor

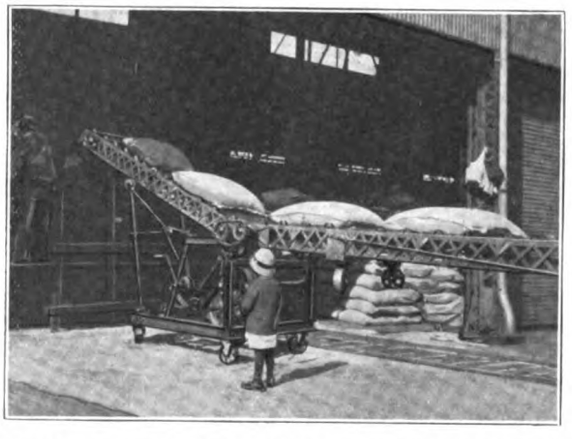

Fig. 6.—Shed End of Portable Conveyor, Elevating Cargo for Tiering

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the whole equipment can then be drawn from place to place by the motor trucks. In the design of this equipment the Brown Portable Elevator Company took into consideration the fact that every steamboat is already

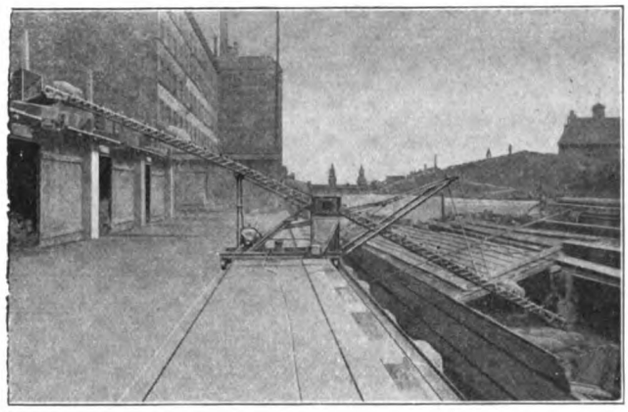

Fig. 7.—Brown Portable Conveyor at Decazeville, France

equipped with hoisting gear, so instead of attempting to bring the packages out of the hold, the ship's gear is used, which brings up a number of packages at a time, delivering them on a table on the deck, from which four men pass them to the conveyor.

The conveyor has a guaranteed capacity of approximately a ton a minute; and in actual work in its initial tests it was operated for five days hauling cement up the 20 percent grade of the Poydras street wharf, and exceeded this guaranteed capacity. Following this, it was operated for three days on coffee, then followed lots of boxes, miscellaneous packages, loose singletrees and other hardware, and within five minutes after the completion of this work it was reversed and 900 bags of rice-hulls were taken aboard the barge.

The large machine in its first tests carried cotton bales of 650-pounds weight up the grade, delivering on trucks inside the warehouse, a distance of 100 feet from the steamer, at a rate varying from 206 bales the first hour gradually up to 300 bales per hour, which is the physical limit for feeding and disposing of the bales. This rate

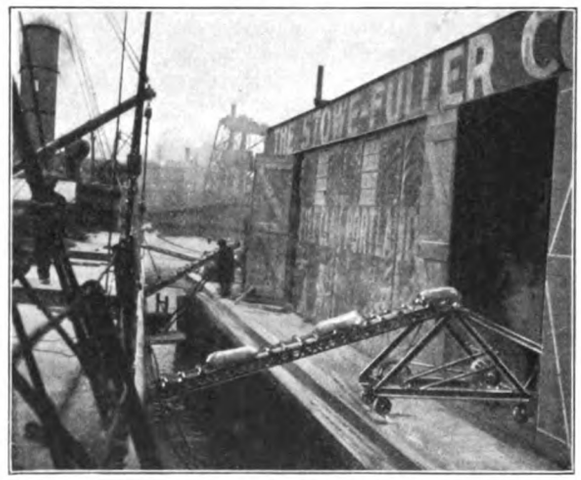

Fig. 9.—Unloading Cement Steamer on Lake Erie with Brown Portable Conveyor, with One-Half the Labor and in One-Third the Time Required for Unloading by Hand

of handling not only reduces the cost by more than 50 percent, but it expedites it to such an extent that exceedingly little time is lost in the work of loading and unloading.

While this New Orleans equipment is a typical example of how the Brown Portable Elevator Company is solving some of the difficult conveying problems presented in terminal work, this company has been successful in placing machines in all parts of the world, and on account of the flexibility of their system it has been adapted with success to the handling of a great variety of packages ranging in weight from flour in 14-pound paper bags to bulky bales of scrap paper of 1,000 pounds.

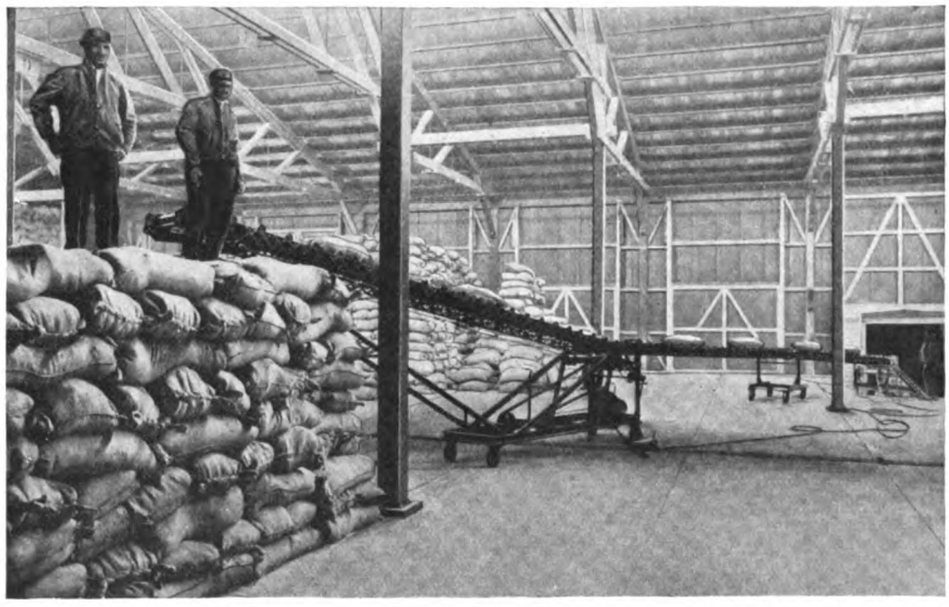

Fig. 8.—Brown-Portable Installation in Baltimore. This Equipment Takes the Bags Out of the Boat, Across the Warehouse and Piles Them to Any Height Desired, Without Any Intermediate Handling, Saving the Cost of Fifteen Laborers, Reducing the Time of Unloading One-Third, Overcoming the Confusion Caused by Truckers, and Making Valuable Much Hitherto Wasted Space

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Reservoir Effects in Freight Movements

Function of the Warehouse in Intermittent Movement of Freight—Extension of the Reservoir Principle to Mechanical Freight Handling Systems

BY ROBERT H. ROGERS *

In mechanics, wherever power is applied intermittently and a constant effect is desired or where both power applied and power transmitted are intermittent or varying, a flywheel is interposed for the purpose of reserving the surplus power and returning same to the system whenever the demand exceeds the supply. The flywheel storage capacity tides the system over its deficient moments.

In like manner, in transportation, the great warehouse systems of the coast cities and of cities bordering on great productive areas are designed to smooth out the peaks and valleys of supply and demand. The warehouses are constantly filling or discharging, completely or in part, to break the abruptness of commercial changes and are therefore valuable fixtures in the broad equipment of the traffic world.

The actual physical work required in the constant filling and emptying of these immense cellular reservoirs, the apparatus needed and used, as well as the proper coordination of the various systems of transferring, elevating and storing present an abundant field for study, and one in which the reward is certain and remunerative.

In a few instances very good results have been attained in the matter of service to warehouses, and in one case there is a great system of warehouses under construction for which the manner and means of all freight movements involved have been carefully laid out in advance and the entire design bent to make every movement simple, inexpensive and rapid. It is expected that this work, when completed, will prove beyond the shadow of a doubt that warehouses should be designed around the transportation facilities rather than to install the transportation facilities by a series of compromises after the warehouses are built.

* Consulting Engineer, General Electric Company, Schenectady, N. Y.

The Pier Shed a Necessary Reservoir

A prominent example of an unavoidable reservoir in freight traffic is the class made up of the pier shed of the seaport and the railroad freight house. These come closer to the main current and are exceedingly numerous and vary greatly in size and manner of performing their duties. Primarily, they smooth out the misses that occur between two or more intermittent carriers, standing, as they do, at the point where the freight is shifted from one form of carrier to another. They are, essentially, flywheels receiving impulses and delivering impulses remodeled as required for the moment.

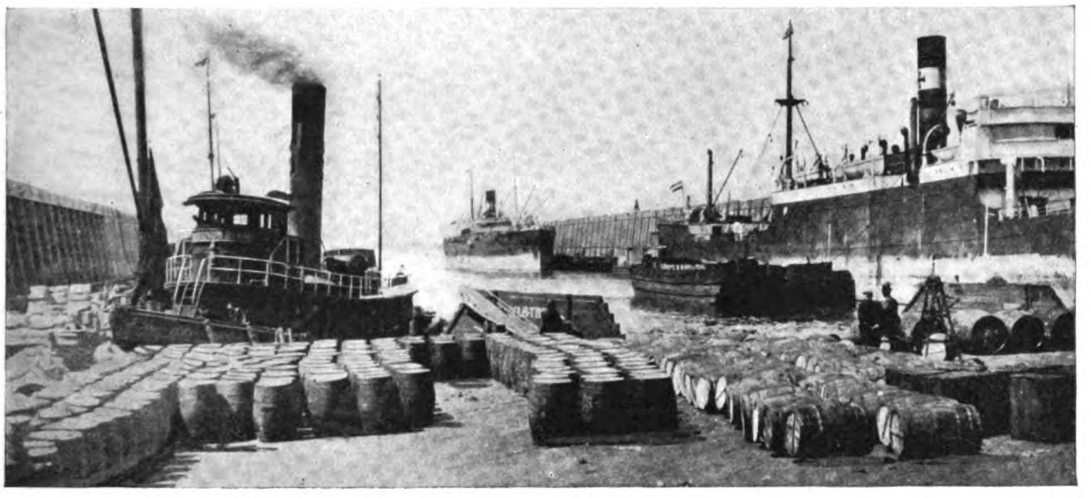

Fig. 1.—Ships Aggregating Three Million Cubic Feet Capacity Can Dock in This Slip at Once

Freight almost never, however desirable, passes directly from dray to car, from car to ship, from ship to car, or car to dray; always there is at least the freight house or wharf interposed. To ignore or to eliminate this essential element in plans is to insure defeat. Admitting the necessity of these pools, it is best to work them into the scheme to advantage and amplify their usefulness.

Transfer terminals of the railroads, when less than carload lots of package freight are transferred from car to car, do not act as reservoirs, for in modern freight practice the freight is not put down at all from car to car. This is so conspicuous an exception that it goes far to prove the rule.

A continuous contact of years with terminals has so far failed to show an instance of package freight, other than perishable fruit, passing directly from ship to car or vice versa. There is the fact that freight cars bring small loads intermittently from many points, while the hold of a great ship requires an enormous amount of freight practically all at once to satisfy its appetite—hence the pier shed becomes an accumulator as a more economic principle than holding the ship for the leisurely arrival of its outward cargo.

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Another consideration of a purely business nature adds to the certainty and perpetuity of the intermediate storage, and that is the matter of checking, weighing, inspecting, sampling, recoopering, etc. To the engineer it would seem as though much of this mauling and man-handling of freight could be avoided or done once for all by some mutual agreement. This phase of freight handling could well form a chapter by itself, for the disturbance recurs at every turn and twist of the traffic and must greatly affect the overall cost of transportation, as it surely does the dispatch.

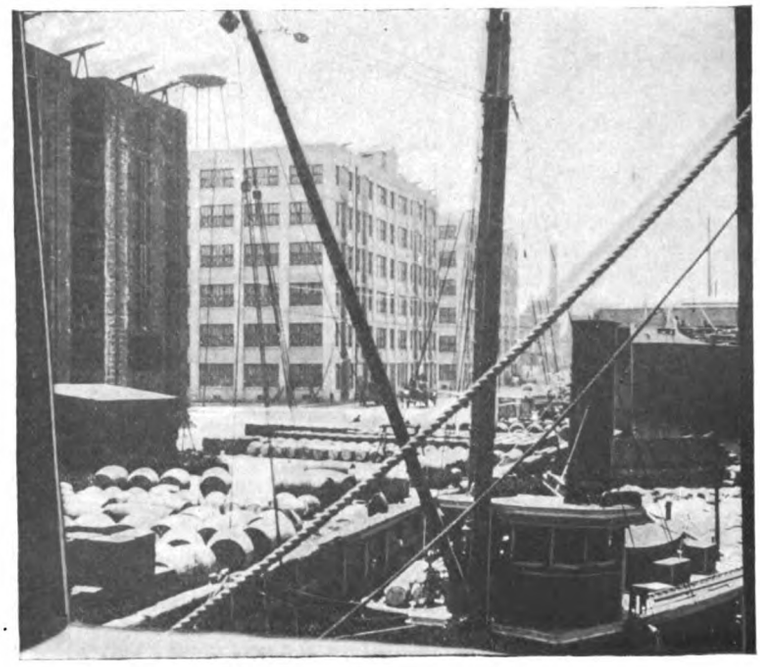

Fig. 2.—Freight Warehouses at the Seaboard Have a Broad Economic Value

Having brought attention to the principal reservoirs now existing and the why of their being, we will turn to the desirability of introducing still more pools, flywheels or reservoirs, as they may be called, where freight is actually being moved. This may seem a long way from the usual mode of attacking freight handling problems, but practice with many old and modern methods and devices has proved again and again that whenever two system or devices are working in series and one or both are of a pulsating or intermittent nature, a reservoir is in order at the junction to permit the full and steady operation of the whole system without delays and congestion.

Reservoirs in Mechanical Freight Handling Systems

As an illustration, a coffee ship is discharging by means of two whips in series onto small four-wheeled hand trucks. Enough hand trucks and crews are provided to haul away the output of the whips; but due to the human equation, the trucks become grouped, so that at times they wait in line for their loads, only later to leave the ship unserved, and the whips must wait for the return of the head of the line. This state of affairs is shown by the two sling loads on deck in Fig. 5, but, unfortunately, the picture does not show the idle gang in the hold. A sloping

Fig. 3.—Wharf Shed Filled with Lemon Cargo to Be Forwarded by Rail

Fig. 4.—Portable Conveyors Furnish a Reservoir Effect by Virtue of Their Capacity

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stage of two or three truck loads capacity eliminated this trouble and boosted the output to the limit of the whips. In this connection it may be mentioned that a portable conveyor offers a still better solution, first, because it affords a continuous instead of an intermittent service, and second, because it is inherently a reservoir by virtue of its surface velocity being greater than the feeding

Fig. 5.—Lack of Reservoir Between Systems Handicaps the Work of Discharging

capacity of the whips, thus constantly presenting a clean surface alongside the hatch.

In a case where a portable conveyor was used to bring cement from a barge up a levee bank to discharge onto industrial trucks for a rather long haul to various piles a similar scheme was adopted, as it was found necessary either frequently to stop the conveyor or litter the floor with cement, which interfered with the electric trucks. A smooth inclined stage of one and one-half truck-loads capacity furnished the needed flywheel effect, so that space was always available for discharging the conveyor and every truck found sufficient accumulation for quick loading.

Another kind of conveying apparatus, namely the

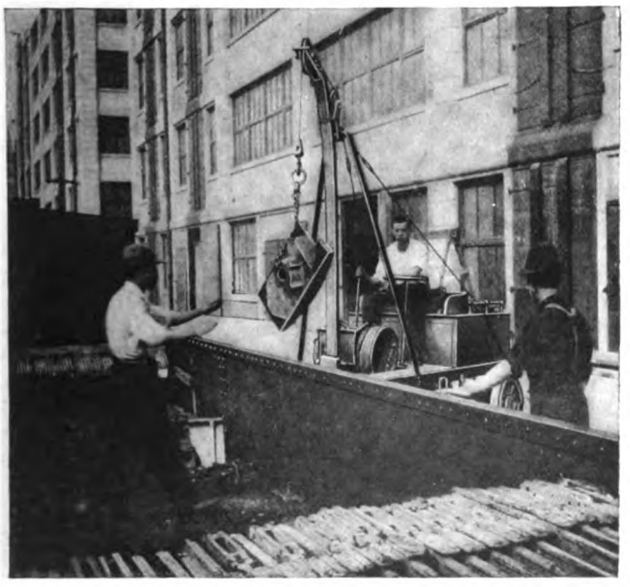

Fig. 6.—Warehouses Hold Railroad Freight for Future Savings

tractor and trailers, has in itself considerable capacity by virtue of using three times as many trailers as are towed at one time by the tractor.

An elaborate and expensive special freight handling machine is brought to mind, in this connection, the failure of which was largely brought about by the lack of any latitude at the discharge end. Mathematical precision was required of the operators at that end, hour after hour, and the eternal human equation not being timed by cams to function at precise instants over long periods of time, nearly wrecked the machine, repeatedly damaged the merchandise and made the work at that end very unpopular. Neither was there any optional capacity provided at the feeding end, and as a consequence the theoretical and guaranteed capacity was quite impossible of attainment.

Commerce is of a willful nature and its appurtenances have not been chosen and held onto through these many years without good reason. To attempt to regulate its comings and goings, its upstandings and downsettings, to accommodate the Utopian ideas of the remote designer is futile and harmful to the general spread of mechanics in freight handling.

For a generation, probably, the general scheme of commercial and traffic inter-relations will change but little, and it is certain that much can be done to reduce costs and better dispatch by the use of machinery—if the present methods are carefully studied and the apparent handicaps are circumvented and made to aid the work in hand.

Marine Terminal Machinery

BY HARRY SAWYER *

While it seems probable that the near future will see rapid development in package freight handling machinery at our American ports, there has been but little progress during the past year to indicate the direction that development will take. A review of the situation and of the factors that must enter into the solution of the problem may be of interest at the present time.

Among the more important factors may be mentioned: Theoretical requirements, present American practices and development in foreign ports. If a clear analysis of our conditions and requirements could be made and complete independence of precedent be granted, the best results might be expected; but however much the engineer might like to attack the problem unhampered, he must recognize extraneous conditions which may prove to be the controlling factor.

Many contend that the common method of handling freight by "burtoning," or swinging the load by the use of two lines, both operated by the ship's winches, is the best. The tendency on the part of some to follow in the paths of European progress is seen in preliminary designs for American piers where the swinging crane mounted on the portal or semi-portal base is shown. But there are reasons why care should be exercised in this course: First, the crane equipment of European ports may not be the best for the conditions there existing; and, second, if well adapted to requirements, it still may not be suited to the needs of our American ports, where somewhat different conditions are encountered.

CRANES AT HAMBURG

In Hamburg several hundred cranes of the semi-portal swinging type have been installed for handling miscel-

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laneous cargo. This foreign port has been compared to our American ports with parallels and contrasts to show that we should and should not so equip our marine terminals. Two local conditions are mentioned in explaining the extensive use of cranes in Hamburg, the great variation in river stage which makes it difficult or impossible to handle freight to and from the quays with the ship's tackle, and the use of barges that must travel under low canal bridges and cannot therefore carry masts for use in handling cargo. While these conditions do not obtain in all our American ports, they are not without parallels in this country. The New York State barge canal is spanned by bridges having a clearance of 15 feet 6 inches above high water, and barges using this canal will not carry masts. The tide variation in some of the Pacific Coast ports exceeds the variation in river stage at Hamburg, reaching 20 feet at Panama, 17 feet in Puget Sound and 27 feet at Prince Rupert, B. C., and making cargo cranes a necessity.

The question of whether handling machinery should be located on ship or on shore should not be determined by a comparison of the different classes of apparatus now in use, but rather by a comparison of the best of each class that can be constructed. As steam is the available power on ships and electric current on shore it becomes a question of steam winches on shipboard versus electric cranes and electric winches on the pier. If it is true that freight can be handled more economically in this country by the ship's winches than in European ports with cranes, the explanation may be found in the type of crane there used. The objections to the swinging crane, including the continued movement of heavy machinery and the long circular path of the load with the resulting sway, are too well understood to need more than a mention here. Cranes are now built that rack the load out and in on a straight line, avoiding the objections mentioned above and retaining the advantage of being operated by one man.

THE SHIP'S WINCH

The steam winch on shipboard usually requires three men, one on each line and one at the engine. Electric winches for use in the pier shed, as generally constructed, follow somewhat blindly the type of the steam winch requiring two men to handle the two lines, but there is no apparent reason why the two lines cannot be wound on drums driven by independent motors and operated by one man.

Cable ways have been suggested having one end anchored to a post on deck and the other attached to the freight shed where hoisting and conveying machinery would be located. This scheme seems to be open to the objection that the cable would be tightened and slackened by movements of the ship resulting from rough water and changes in load and tide, unless automatic means were provided for keeping a uniform tension. Electric loading and unloading machinery is now in the formative stage and in the early part of that stage. The same cannot be said of the steam winches mounted on the ship's deck. To consider the probable future of these two classes of machinery is by no means to indulge in idle speculation.

The practice of putting the cargo handling machinery on the ship came about, of course, by necessity, because of the large number of ports entirely unequipped. Will this necessity perpetuate itself? And if the necessity is not perpetuated, will the practice continue through sheer inertia?

If an engineer had free hands, unhampered by existing equipment and prejudice, it would seem the common-sense plan to place the handling machinery on shore, rather than load the ship down with deadweight, which serves no purpose during transit except to reduce its cargo-carrying and hence earning capacity.

It would be revolutionary to strip existing ships of their cargo winches and equip all piers where they land with handling machinery; but considering that some piers are now so equipped and must be for reasons mentioned above, it seems possible that the change may come about by degrees, the steam winches on ships gradually giving way to the more economically operated, more easily controlled and not less rapid electric cranes and winches on shore. Comparing the electric winch and the overhead cargo crane, the winch has the advantage of adaptability to existing sheds. The crane, while requiring a shed constructed to carry it and costing more per unit, has the advantage of economy of room, leaving the floor entirely unobstructed, and of being much more readily movable, reducing the number of units required.

LOCATION OF FREIGHT SHED

In Hamburg, as in many other European ports, the freight sheds are set back sufficiently from the edge of the piers or quays to provide room for one or more railroad tracks, which are spanned by cranes. In our most important port, New York, peculiar conditions are found. As most of the piers on Manhattan Island are without railroad connections, no tracks are provided, and sheds are built within four to six feet of the sides of the pier. There are reasons to believe that this New York type has had an undue influence on other American ports where conditions are quite different.

There is not at the present time any accepted practice in this country in the location of tracks on piers. They are in some cases run through the center of the pier shed, in others outside of the shed along the side of the pier, and in some cases in both locations. Tracks through the center of the shed are usually depressed to bring the car floor approximately on a level with the shed floor, but there is no established practice in grade of tracks placed outside the shed. In our Pacific Coast ports may be found examples of the pier without railroad tracks alongside the shed, of the pier with one track, and of the pier with two tracks on each side. These outside tracks are in most cases flush with the pier deck, though in some cases depressed, and in some instances the track along one side of the pier is flush and that along the other side depressed.

This difference in practice in the location and grade of tracks is probably justified in some cases by different local conditions, but in many others it seems to reflect the engineer's opinion of the requirements of a business yet to be developed. There is not the same advantage of tracks along the side of our piers as there is in European ports, where open cars are used much more generally. Considering the fact that consignments are often badly mixed as they come from the ship's hold, making it necessary to sort the freight before it is loaded into cars, and that much of that to be reshipped by rail must go in box cars which cannot be served by cranes or winches, a comparatively small proportion of inbound miscellaneous cargo can be transferred directly from ship to cars. A larger proportion of outbound freight can be handled direct, as less sorting is required. The economy of direct handling is so great that it should be employed where possible.

HANDLING FREIGHT INSIDE THE SHED

Economical handling of freight inside the shed presents a difficult problem. For handling light package freight short distances, and particularly that which need not be

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tiered for storage, nothing will probably ever supersede the hand truck, but for long distances some means that is much more rapid than the hand truck and requires less labor is needed. The storage battery truck and the overhead monorail system are competitors in this field. Progressing along the line of least resistance, the storage battery truck has been more frequently adopted. It can be more easily installed, as it will run in any old shed where a reasonably smooth floor is found, and it can be tried on a smaller scale. The overhead system requires a stronger building with more headroom and a more expensive initial installation. The advantage of greater speed, of economy of floor space and of being a hoisting as well as a conveying machine should count in its favor and find it a place in competition with the more easily installed and very useful battery truck.

In the development of freight-handling equipment, both for loading and discharging cargo and for distributing it in the shed and storage warehouse, it must for some time remain an open field between that which offers the easiest transition from our present crude methods and that which promises the best results in economy and speed—between the storage battery truck and the overhead track system—between the electric winch and the overhead wharf crane.

Points of Attack in the Terminal Problem

Possibilities for Reduction of Terminal Charges for Handling Freight—Faults to be Overcome in the Existing Conditions

BY JAMES A. JACKSON *

Perhaps there has never been a time in the history of the country when the maxim "In times of peace prepare for war" applies as forcibly to the freight handling business as at present. We are just recovering from a severe business depression, and if history repeats itself and the predictions of our masters of industry are fulfilled, we are on the verge of an era of prosperity which will make the good times of the past look dull and uninteresting. The Panama Canal has just opened and is stimulating both our coast-to-coast and foreign commerce in a remarkable way. The great European war has awakened our financiers and captains of industry to the great opportunity presented to build up an enormous South American trade; and it must be done rapidly, or the opportunity may be hopelessly lost. The war has also made our Government see daylight and stop playing politics on the merchant marine question, and laws either have been or will be made which will once more make it profitable for an American-owned vessel to sail under the Stars and Stripes. Thus no stretching of the imagination is necessary to predict a freight tonnage in the near future far ahead of anything we have ever seen.

Now the important question is: What will the freight bill amount to and how can it be reduced? At the present time we pay a transportation bill approximately three times our combined national, State and local taxes—truly an enormous amount. The freight carriers and handlers are interested from the standpoint of increasing profits, the manufacturers of machinery from the standpoint of obtaining new business, and the public from the standpoint of decreasing the high cost of living; therefore, a short analysis to show where the "high spots" in transportation costs exist and a few broad suggestions for reducing these "high spots" should be pertinent.

Fig. 1.—Pier Showing Wasted Headroom. This Headroom Could be Utilized by Mechanical Stackers and Tierers

Fig. 2.—Handling Freight on a Storage Battery Industrial Truck. Load Shown Would Make 8 or 10 Hand Truck Loads

REDUCING TRANSPORTATION COSTS

James J. Hill, who is perhaps the country's leading authority on transportation questions, has said: "Its (the country's) prosperity as a whole and the welfare of every man in it, who engages in any gainful occupation, can escape threatened disaster only by such additions to, and enlargements of, existing facilities and terminals at our great central markets and our principal points of export as will relieve the congestion which now paralyzes traffic when any unusual demand is made upon them." How true this is can easily be seen when we find that by rail freight is hauled for three mills per ton mile and by water the cost is seven-tenths of a mill per ton mile, while the cost per ton for terminal handling by present methods varies from probably fifteen cents to seventy-five cents ((0/7½ to 3/1½), depending on the conditions and material handled. The average would probably be about thirty-five cents (1/5½) per ton. When it is considered that our railroads are handling something over a

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Fig. 3.—Two Men, with Hand Truck, Handling Coffee in Nine-Bag Loads. There Were 81,000 bags in This Cargo. Compare This with the Conveyor Method

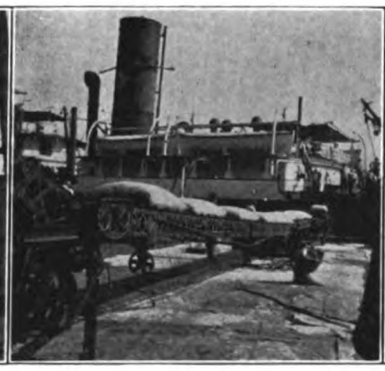

Fig. 4.—Unloading Coffee to Wharf Shed 100 Feet from Ship and Elevating Coffee in the Shed by Electrically-Driven, Portable Conveyor

Fig. 5.—Portable Conveyor Carrying Coffee from Ship's Deck to Wharf Building at Rate of 1,800 Bags per Hour by Electrically-Driven Portable Conveyor

billion tons of miscellaneous freight per year (coal and ore excluded), it will be seen that a saving of only one cent (0/0½) per ton in terminal handling, assuming each ton to go through only one terminal, would save $10,000,000 (£2,050,000) annually. Assuming $5,000,000 (£1,025,000) of this to go to additional profits and reduced charges to the public and then capitalize the other $5,000,000 (£1,025,000) at 5 percent, making $100,000,000 (£$20,500,000) and we have some idea how much could reasonably be spent to save that one cent (0/0½) per ton at the terminals.

How to spend that $100,000,000 (£20,500,000) can be answered broadly in one word—"machinery." There is any quantity of machinery on the market to-day, eminently fitted for the work, provided it is intelligently selected and handled; and if a general demand for machinery is created, apparatus will be designed to fill the gaps which existing machinery cannot fill. This demand, then, must be created, and it must be done through an educational campaign which will be so forcible and so well "hammered in" that even the most obstinate will be convinced.

An Educational Campaign Imperative

Consulting engineers and dock and pier architects could exert a very valuable influence by laying out all new work with the idea of making it most adaptable to the use of machinery. This would soon result in some exceedingly efficient pier or terminal which could be pointed to as a convincing example of how to handle package freight. At present there is no such example in existence, while there are one or two failures due to recommendations being made without a thorough study of the subject.

Machinery and electrical apparatus manufacturers, where large enough to justify it, could develop specialists who could give their time to analyzing various freight terminal situations with a view of recommending machinery best adapted to meet the special conditions. It might be well at this point to add a word of caution—namely, that it would be bad business for a specialist to recommend his own machinery just to make a sale when his own judgment tells him it is not the very best apparatus for the place.

Large central stations supplying electric power can assist in this educational work to their advantage by training their power solicitors to go after this dock, pier and terminal business in an intelligent way. Many solicitors, no doubt, do not realize the opportunity to get business because they are not sufficiently familiar with the conditions to know any arguments whereby the power they have to sell can be used to reduce costs and conserve floor space. Electricity is, without doubt, the most desirable power to use on account of its flexibility and the large electrical manufacturers will be glad to co-operate with the central station in securing this business. In

Fig. 6.—Four Mules Drawing 14 Bales of Cotton Three Miles per Hour. Compare This with Battery Truck Crane Towing 4 Tons of Coffee at 4 Miles per Hour over Reasonably Smooth Pavement

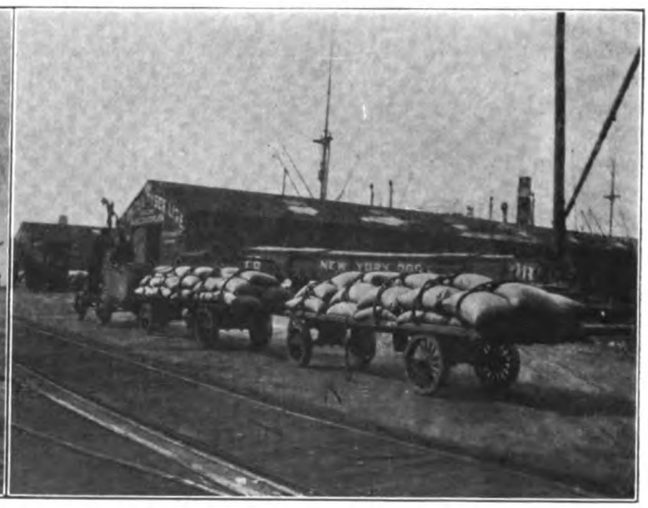

Fig. 7.—Battery Truck Crane Towing 50 Bags of Coffee from Wharf Building to Warehouse. The Rope Slings Are for Hoisting the Bags to Upper Floors

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many places storage battery trucks and truck cranes can be used very efficiently, and this is a most desirable form of load for central stations, as arrangements can usually be made to charge the batteries during light load periods, thus improving the load factor.

The terminal and pier owners will not only have to educate themselves to see the advantage of installing machinery, but will then have to educate the roustabout freight handler to use the machinery efficiently. An official of a large municipal dock, and a strong advocate for the use of machinery, recently said that you could supply two stevedoring companies with the same machinery to do the same work and one company would break even or possibly clear 10 percent over old hand methods, while the other company would clean up 200 percent profits.

5. Replacing existing mechanical apparatus with improved and more efficient apparatus. For instance, electrically driven apparatus could be substituted for slow and inefficient steam, hydraulic and animal-operated apparatus in many places to advantage—also electric trucks could be advantageously used instead of hand trucks.

6. The addition of new machinery to work along with old to improve the plant efficiency as a whole. An instance is in the writer's mind where the addition of a chain sling at a cost of about $2 (8/4) just doubled the efficiency at which $3,500 (£718) worth of apparatus was being worked.

7. The design of vessels, barges, lighters, etc., to make them more adaptable to the use of rapid freight handling devices.

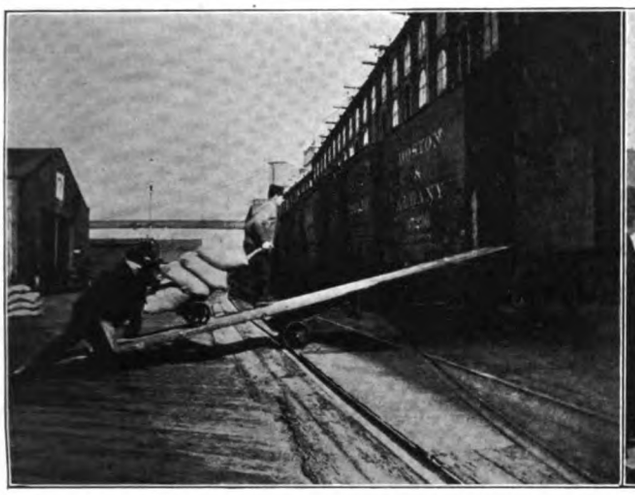

Fig. 8.—Loading a Freight Car by Hand Under the Brooklyn Bridge. Compare This with Battery-Truck-Crane Method

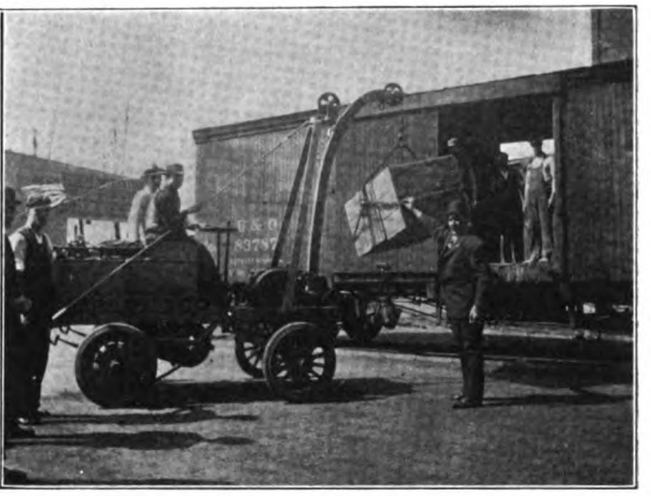

Fig. 9.—Loading Box Car with Storage Battery Truck Crane. Handling Three 300-pound Boxes per Minute from 75 Feet Away from Car Door

As this official spoke from experience, it shows what must still be accomplished after machinery is installed.

POSSIBILITIES FOR REDUCTION OF TERMINAL CHARGES

In addition to education, a list of subjects, with short comments, is given below, all of which offer big possibilities for the reduction of terminal charges for handling freight.

1. The design of new piers, terminals and warehouses, especially adapted to the use of machinery. Close cooperation between consulting engineers, architects and machinery manufacturers should do much to accomplish results along this line.

2. The redesign of existing piers, terminals, warehouses, etc., to adapt them to the use of machinery.

3. The possibility of using wet docks where tidal conditions are bad. This would overcome all variation in the vessel's height except that caused by the change in load. If the dock was made to accommodate a single vessel, large low-head pumps might be employed to hold the vessel stationary, regardless of load, by varying the height of water in the dock. This stability might permit the use of some form of conveying apparatus which would so lessen the time and cost of unloading that the expense of the wet dock and pumps would be justified.

4. Installation of mechanical devices in existing buildings with no change in the design of the building. This is one of the most important fields there is to work in and at the same time one of the hardest in which to accomplish the best results.

8. The modification of existing vessels, lighters, barges, etc., to make them more adaptable to the use of rapid freight handling machinery.

9. The design of special freight cars for miscellaneous package freight. It appears that the present box cars are seldom loaded to their capacity, which means that they are inefficiently operated. It seems that a much lighter and perhaps smaller car with a removable top as well as side doors could be used far more efficiently.

10. The consolidation of railroad and steamship terminals, together with warehouses and manufacturing concerns, at common points. This is more a question of financing and could probably be best handled by development companies.

11. Devising a more rapid system for handling freight cars in freight yards. An enormous amount of time is now lost between the time a car arrives at the edge of a city until it is spotted for unloading, and both time and money could be saved by improving this situation.

12. The standardization of the size, shape and weight of packages. Anything accomplished along this line would make the use of machinery far more simple.

13. The study of foreign methods of freight handling.

No doubt, many more suggestions could be made, but the above seem to offer the largest possibilities.

AMERICAN REGISTRY OF FOREIGN-BUILT VESSELS.—Up to and including February 20, a total of 129 foreign-built vessels, aggregating 468,509 gross tons, had been given American registry.

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Barge Canal Terminal

Proper terminal facilities at Rome, N. Y., on the new State $100,000,000 (£20,500,000) barge canal system demanded the construction of 900 feet of dock parallel to, and only a short distance from, the canal channel. The method of construction adopted for this dock consisted of an anchored bulkhead wall made of Lackawanna steel sheet piling capped with reinforced concrete and tied to a continuous line of wooden piles driven 40 feet back of and parallel to the bulkhead, as shown in Fig. 1. A trench was excavated and the bulkhead of steel sheet piling wall was that of M. A. Talbot & Co., amounting to $91,594 (£18,870).

The wall has now been satisfactorily completed, as shown in Fig. 3. Fig. 2 shows the wall of Lackawanna, 14-inch by ⅜-inch arched web steel sheet piling driven in 26-foot lengths. Also the system of reinforcing rods used to hold the protecting concrete on the top 8 feet of the wall is shown in the photograph. The material to be taken out by hydraulic dredging is shown on the left of the sheet piling wall. The bulkhead wall was entirely completed before any dredging was done.

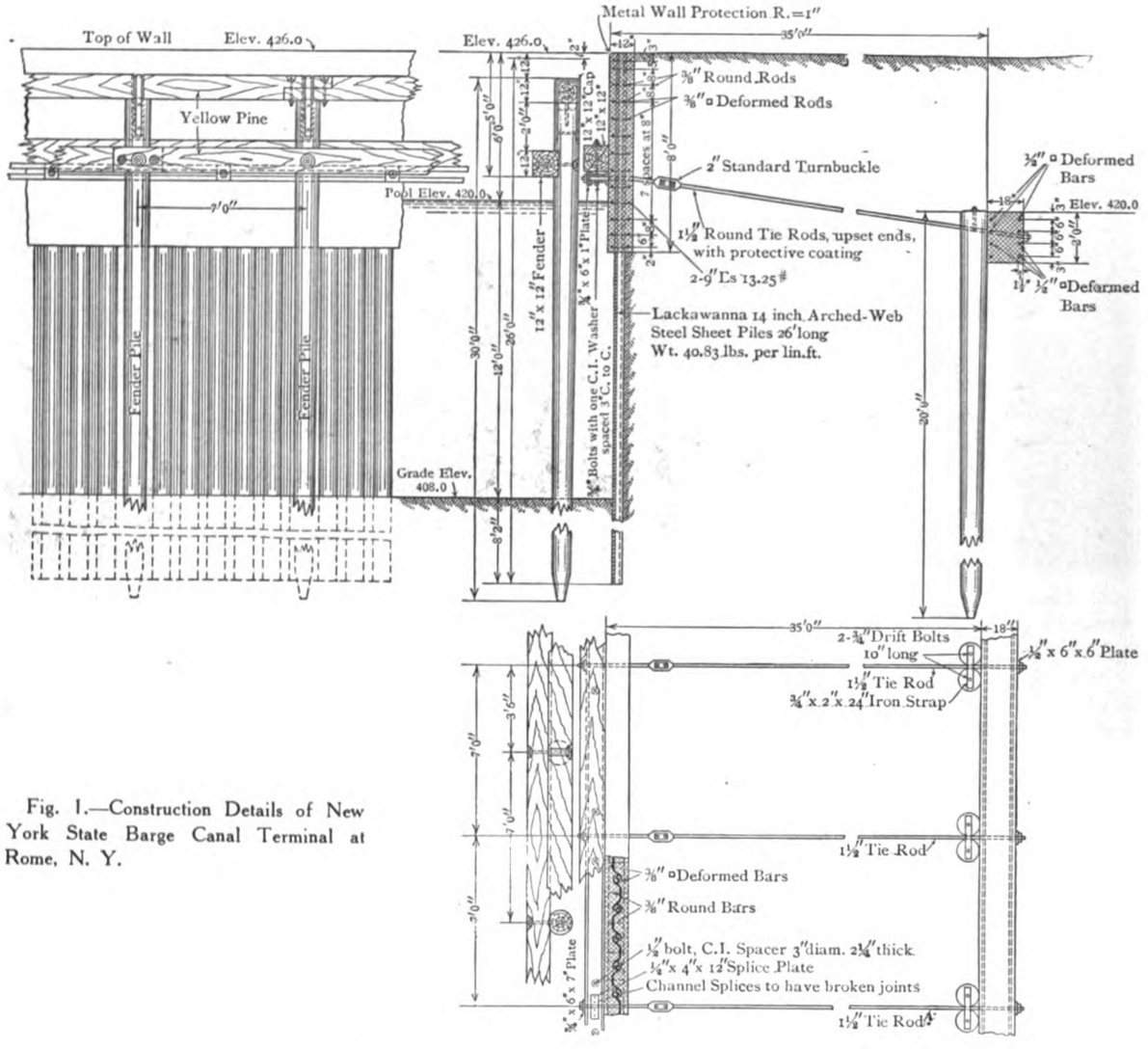
Top of Wall
Elev. 426.0
Yellow Pine
Pool Elev. 420.0
Fender Pile
Fender Pile
Grade Elev. 408.0
Elev. 426.0
Metal Wall Protection R.=1″
⅜″ Round Rods
⅜″ □ Deformed Rods
2″ Standard Turnbuckle
1½″ Round Tie Rods, upset ends, with protective coating
2-9″ Es 13.25#
12″ x 12″ Fender
¾″ x 6″ x 1′ Plate
Bolts with one C.I. Washer spaced 3′ C. to C.
Lackawanna 14 inch Arched-Web Steel Sheet Piles 26′ long
Wt. 40.83 lbs. per lin.ft.
⅝″ □ Deformed Bars
Elev. 420.0
1¼″ ⅝″ □ Deformed Bars
2-¾″ Drift Bolts 10″ long
1½″ Tie Rod
¾″ x 2″ x 24″ Iron Strap
⅜″ x 6″ x 6″ Plate
1½″ Tie Rod
⅜″ □ Deformed Bars
⅜″ Round Bars
½″ bolt, C.I. Spacer 3″ diam. 2¼″ thick
¼″ x 4″ x 12″ Splice Plate
Channel Splices to have broken joints
¾″ x 6″ x 7′ Plate
1½″ Tie Rod

Fig. 1.—Construction Details of New York State Barge Canal Terminal at Rome, N. Y.

ing driven to a point several feet below the canal grade. The top 8 feet of this steel sheet piling was incased within a narrow wall of concrete, while large steel tie rods, spaced 6 feet apart lengthwise of the walls, anchored the bulkhead to the line of wooden piles back of the wall.

It was figured that the use of steel sheet piling in this way would involve considerably lower costs than in the construction of a mass concrete gravity wall in deep excavation where a greater quantity of sheet piling would be required for cofferdams and where the expense of maintaining such cofferdams dry during construction would add a large item to the cost of construction. The lowest bid submitted for the concrete top steel sheet

Fig. 3 shows the dock completed with the exception of making the final grade. It will be noted that the Lackawanna steel sheet piling, when driven, has been formed to a true line throughout its length, so that by making the foundation concrete reinforcement 14 inches thick overall, the entire length of the dock face, 900 feet, was in an absolutely straight line on both the front and back sides of the wall. No protection of the steel piling against corrosion, other than the concrete on the top 8 feet, was considered necessary.

The construction of this dock was supervised throughout by J. A. O'Connor, terminal engineer, and Guy L. Noble, division engineer in charge, department of engineer and surveyor, New York city.

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Facilities for Shipping and Freight Handling at River Ports*

BY E. E. R. TRATMAN †

Success in the development of inland navigation depends in large measure upon the efficient, economical and prompt handling of shipments at the river ports. The cost of carrying freight between ports is small, but the cost of handling freight at the terminal points is a large item in the total cost of transportation. And it must be remembered that difficulties, delays, expenses, damages and losses to freight at these points will soon tend to discourage shippers.

The facilities to be provided include suitable accommodation for vessels (whether steamboats or barges) and suitable means for handling the freight. They must be adapted, of course, to the local conditions in each case. These facilities may be classed as follows:

1. A water-front channel of proper depth, width and location. This is a matter for the joint consideration of the local authorities and their engineers, and the War Department or U. S. engineers.

2. Boat landings, with levees, wharves, piers, water-front freight sheds, warehouses, etc.

3. Mechanical equipment for handling freight to and from the boats. This includes fixed or traveling cranes, hoists, portable conveyors for freight or freight trucks, small motor freight trucks, etc., the equipment varying, of course, with topographical and traffic conditions at each point.

4. Rail connections between the river front and the railway lines entering the city or town. Many ports may have a considerable amount of transfer or rail-and-water freight, and for the economical handling of this it will be very desirable to transfer freight directly between boats and cars.

*From an address at the River Terminal Conference at St. Louis, February 18-19.

†Western Editor of *Engineering News*.

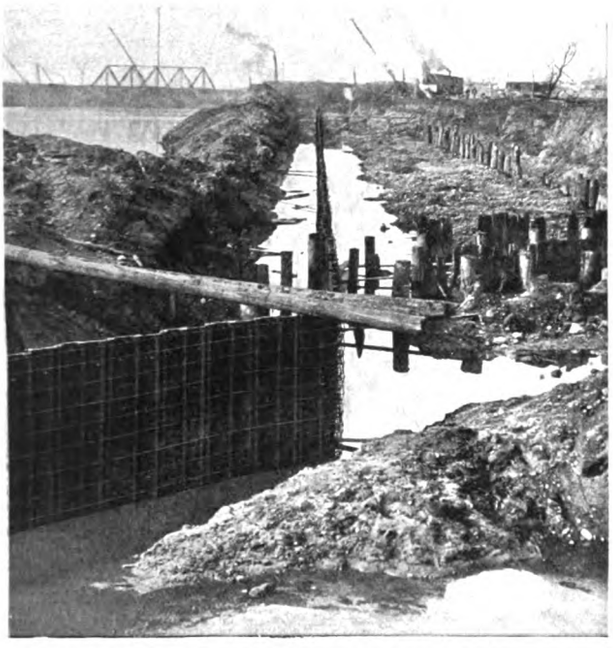

Fig.2.—Steel Sheet Piling Bulkhead Wall Under Construction, Showing Reinforcement for Concrete Cap

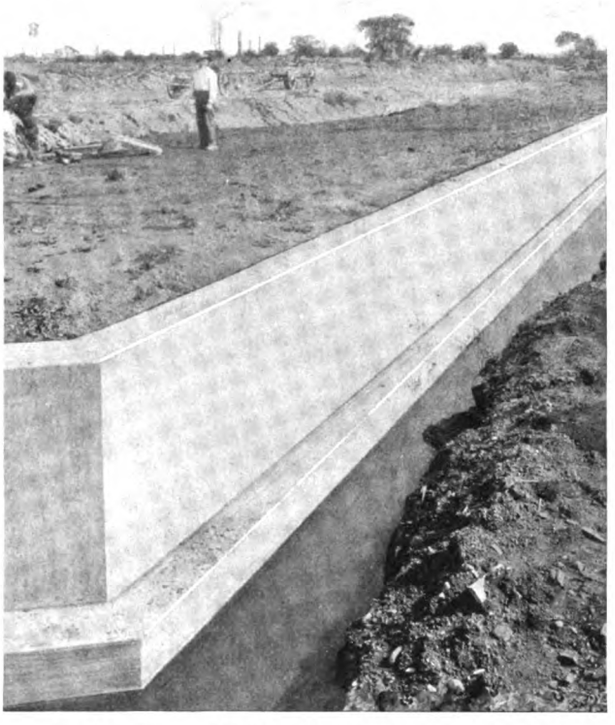

Fig. 3.—Completed Wall Before Dredging and Grading

River Freight Traffic

A very desirable line of inquiry is in regard to the present and prospective traffic at various river ports. That is, the amount and character of the freight. Estimates have been made at various times, but many of these are somewhat rose-colored and based largely on guesses in which hope is the father of the figures presented.

But for the cold, calm business proposition of operating river traffic to advantage it is very desirable that there should be some reliable and reasonable statement as to the character and amount of traffic to be handled.

This applies not only to the general proposition of developing river traffic, but also to the determination of the character and cost of the facilities to be provided in each individual case.

MUNICIPAL STEAMBOAT LANDING AT PEORIA, ILL.—The steamboat landing at Peoria, Ill., on the Illinois River, was originally a bulkhead wall for the landing of freight to and from the boats, but was inconvenient owing to the varying stages of the water level. The city decided to improve conditions by removing this bulkhead for a length of 1,350 feet and building a heavy paved bank or levee from which gangways could be laid to the steamboats at any stage of the water. At present this has been built for about 850 feet, with a retaining wall at the end to support the bank.

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Freight Handling at Havana, Cuba

New Reinforced-Concrete Steamship Piers at Havana Equipped with Efficient Means for Handling Freight

The Port of Havana Docks Company has recently completed the erection, in Havana, Cuba, of two reinforced concrete piers, called the San Francisco and the Machina piers, each two stories high, 164 feet wide, and 660 and 680 feet long, respectively. The two structures are connected by a four-story head house, located opposite the Custom House. The bulkhead building is 740 feet long, 66 feet wide, four stories high in the center portion, three stories high at each end, with a central tower 105 feet high. The entire structure is supported on 4,000 concrete piles and the water depth about the piers is from 12 to 40 feet.

Fig. 1.—Bulkhead Building at Head of New Havana Steamship Piers

The design of these piers was undertaken by Barclay, Parsons & Klapp, consulting engineers of New York, and the general contractor was MacArthur, Perks & Co., Ltd., of Ottawa and New York. The concrete construction follows the very latest practice and includes some interesting features, to which considerable attention was given in the engineering press.

The general arrangement and equipment provide for handling an immense amount of freight with the greatest possible dispatch and efficiency. Practically all freight that comes into Havana is unloaded at these piers, whereas formerly it was lightered at excessive cost to and from the vessels anchored in the harbor. The equipment of the buildings, for handling all this freight, was given very careful attention by the engineers; this was especially necessary, as the boats unload at the first floor level and a very large part of this freight is shipped out from the second floor level. It was at first planned to use a number of platform elevators, but this would have caused a considerable waste of time with the men going up with the trucks and returning empty; the idea was therefore abandoned and two freight escalators were worked into the design, one of which is shown in Fig. 5.

The two escalators, designed and manufactured by the Stephens-Adamson Manufacturing Company, Aurora, Ill., are identical in construction and size, each being 48 inches wide by 55 feet long. Both upper and lower ends are curved flush with the floors and the main portion of each is inclined about 28 degrees. The construction consists of two strands of heavy steel bar roller chain, 6 inches pitch, running on steel angles and carrying 3-inch maple flights closely spaced. The escalators deliver the boxes and packages on the second floor. Above this floor is a 20-ton traveling crane of 30-foot span, and directly below the crane is a depressed trough containing two standard gage tracks, which connect with the elevated railroad of the city. This arrangement allows for unloading freight directly from ships to cars, or vice versa, without extra handling. As compared with the former methods in vogue in this port, when all of the freight was lightered to and from the ships anchored in the harbor, at a cost of about $2 (8/4) per ton, the saving in the cost of

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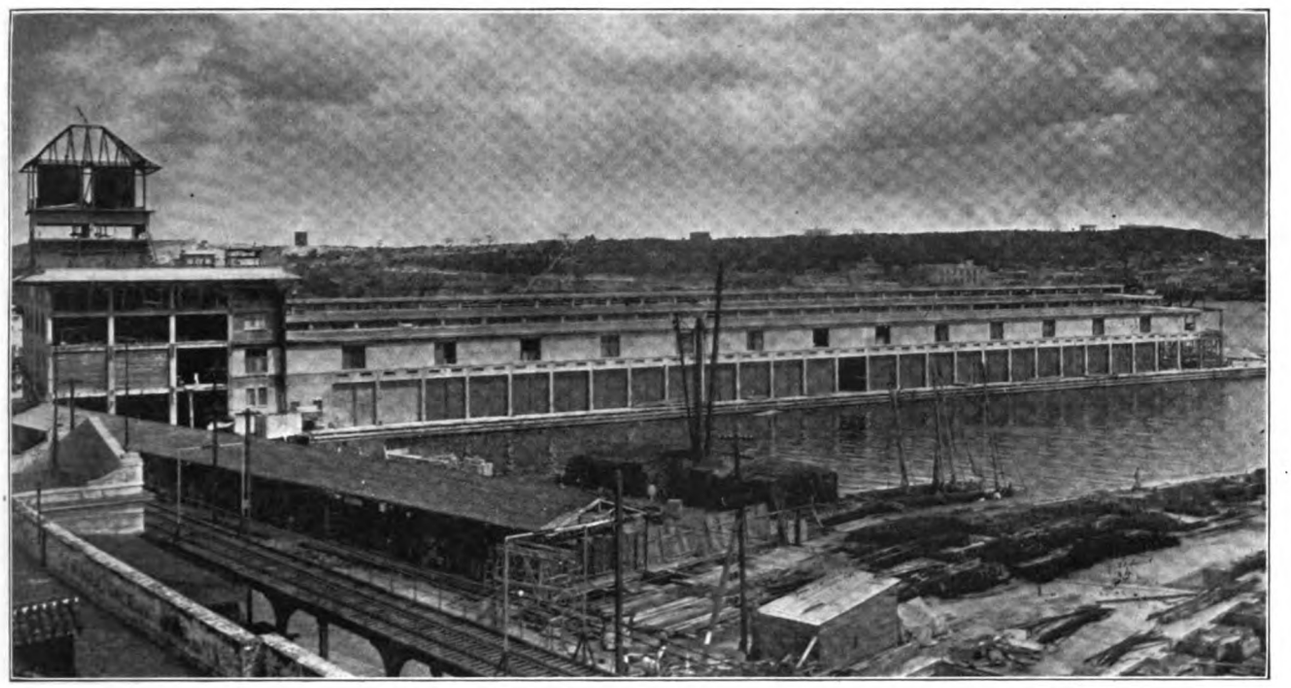

Fig. 2.—View of New Havana Piers during Construction, Showing One Pier Completed and a Portion of the Other Ready for the Superstructure

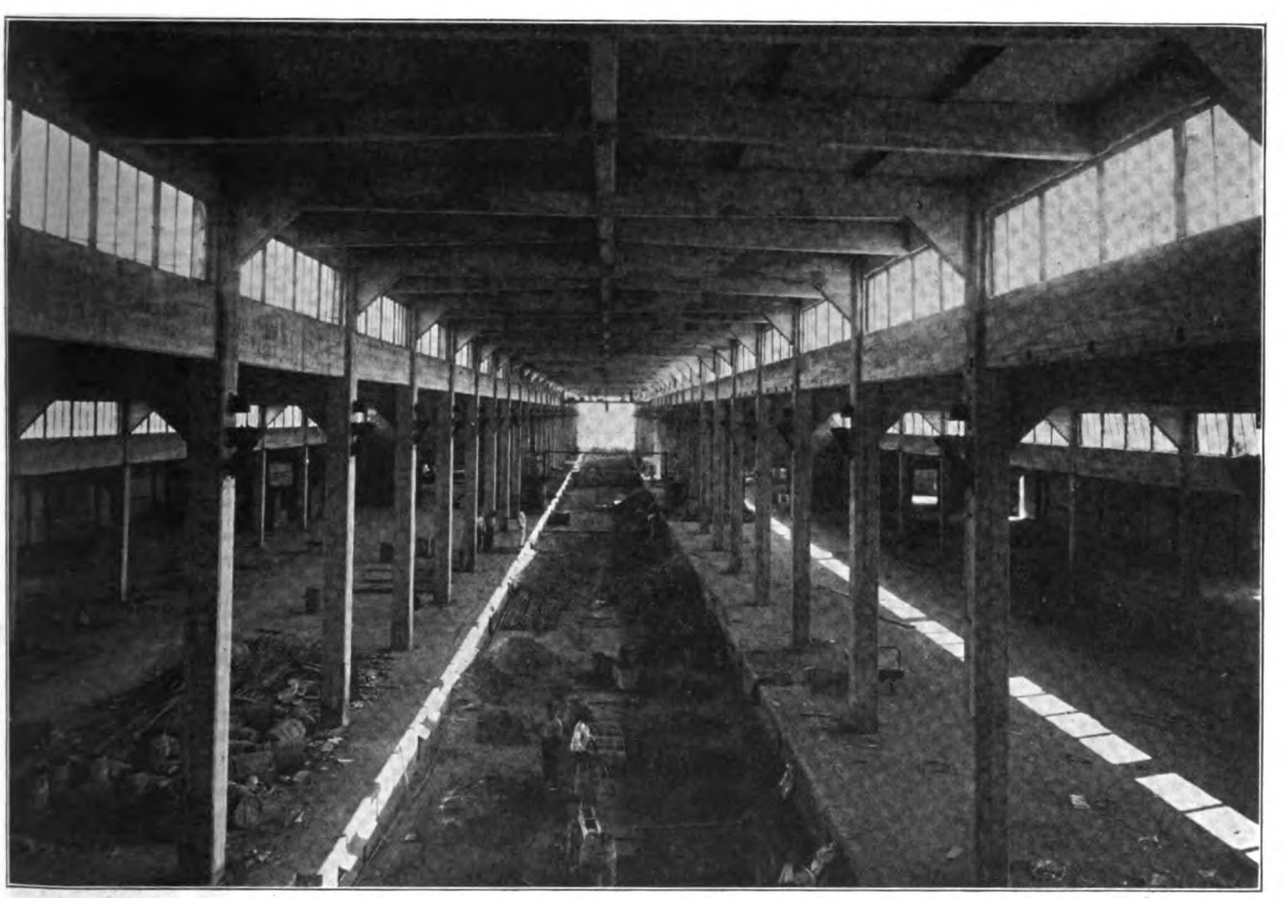

Fig. 3.—Upper Story of Pier Shed, Showing Ample Lighting and Location of Depressed Tracks for Connection to the City's Elevated Railroad System

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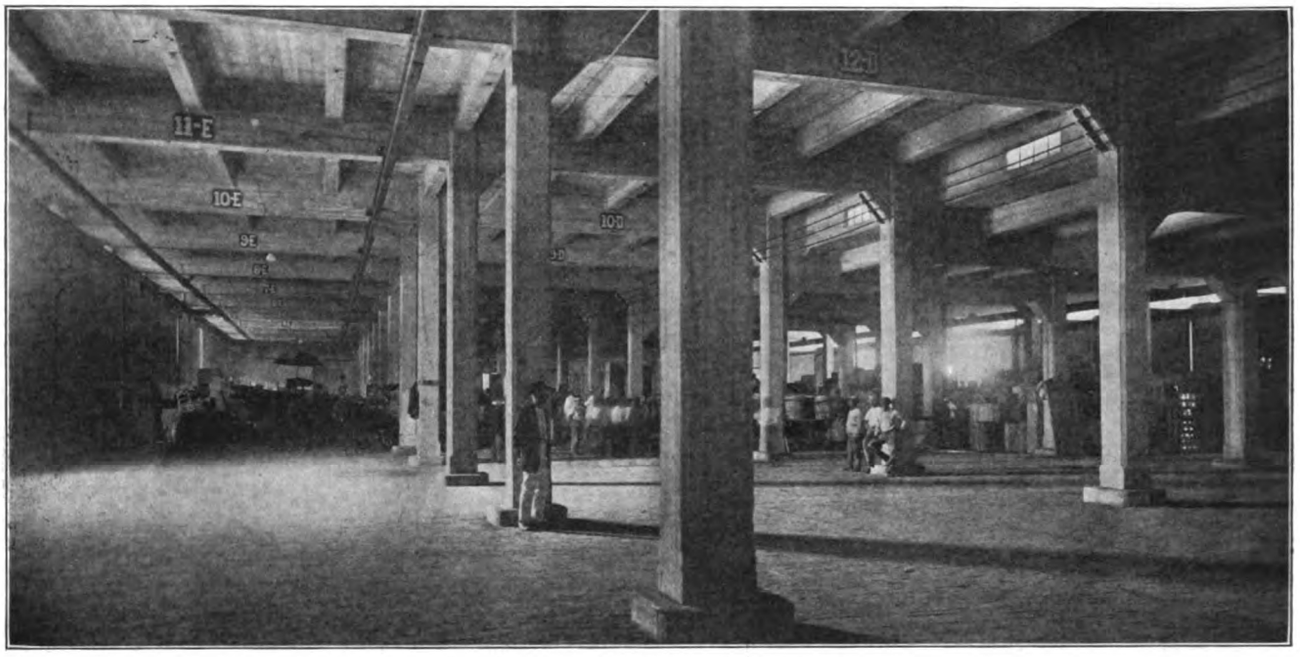

Fig. 4.—Lower Story of Pier Shed, Showing Type of Reinforced Concrete Construction

handling freight is apparent, to say nothing of the elimination of the confusion and congestion that formerly prevailed at the old piers.

TERMINAL IMPROVEMENTS AT OAKLAND, CAL.—From $16,000,000 to $20,000,000 is being expended by the railroads at Oakland, Cal., on terminal improvements to provide facilities for handling about 2,500,000 tons of freight annually. In addition, municipal wharves have been built by the city giving about 3,500 feet of berthing space, at which it is expected about 500,000 tons of additional maritime commerce will be handled during the year.

Fig. 5.—Escalator Running from First to Second Story of Havana Pier

Barges Equipped with Brownhoist Locomotive Cranes for Handling Coal

The Dominion Coal Company, at Montreal, Quebec, has two barges of 1,000 tons carrying capacity each, fitted with Brownhoist locomotive cranes with grab buckets, as shown in Fig. 1. The barges have open hatches 16 feet wide, extending practically from stem to stern. The frames of the cranes have a gage of 16 feet and run on a track of the same gage, so that they can be moved to any part of the barge and unload the coal with a minimum of trimming.

The booms of the cranes are 50 feet long, which enables the bunkering of the largest transatlantic steamers. The cranes are also equally effective for bunkering

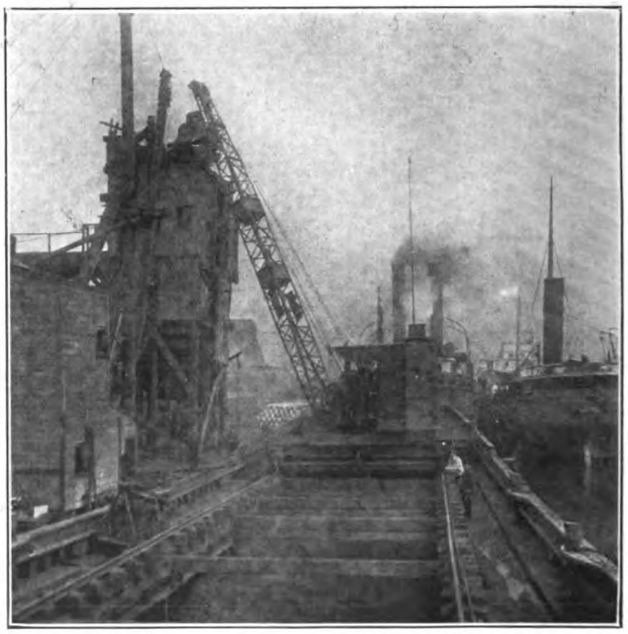

Fig. 1.—Dominion Coal Company's Coal Barge, Fitted with Steam Locomotive Crane

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through side ports, a hopper being inserted into the port holes so that the coal is fed directly into the bunkers. The barges can also be used for delivering coal to manufacturing plants situated on the canals or on the waterfront.

Another similar application of a 15-ton Brownhoist locomotive crane with a 54 cubic foot grab bucket is used by the Astoria Light, Heat & Power Company, Astoria, Long Island.

Inclined Elevators Increase Economy of Marine Terminals

As most of the package freight on American coastwise vessels is loaded and discharged by trucks through side ports, the variations of tide and of the draft of the vessel while at the pier necessitate handling the trucks up and down inclines of varying grades. Obviously, as the grade increases, more men are required to push a given load up the incline and the time required for the operation is increased. To overcome this difficulty and to reduce both the time and cost of handling freight at the terminals, the Otis Elevator Company of New York has developed a continuously running inclined electric elevator capable of drawing ordinary trucks with loads up to 1,000 pounds up an inclined gangway at speeds of 125 to 250 feet per minute. The cost of power for operating the elevator is about one-tenth of a cent per ton and reports from users show savings of 13 to 15 percent in the cost of handling freight and a reduction of 15 to 20 percent in the time required for discharging a vessel.

The inclined elevator consists of an endless chain which runs in a lubricated steel channel, and is provided with special projections which engage with the axles of the trucks. It will be seen from the illustrations, which show one of four inclined elevators installed at Pier 5 of the New York Central & Hudson River Railroad at Weehawken, N. J., that the chain is driven by a sprocket wheel whose shaft is connected through reduction gearing to an electric motor on the pier floor. The motor is of the alternating current type, wound for two speeds, driving the hauling chain at speeds of 125 to 250 feet per minute. The object of the two speeds is to permit slowing up the elevator to handle unusually heavy loads. On the outer end of the motor shaft is a brake pulley and an electric brake equipment which stops the elevator whenever the current is shut off. This feature is of importance, as it is now the practice to load the trucks to their full capacity, with the result that occasionally one of the packages falls off, and it is important to stop the elevator and hold it securely with the line of trucks still engaging the chain while the package is replaced on the truck.

Fig. 1.—Otis Inclined Elevator in Operation at Pier 5 of the New York Central & Hudson River Railroad at Weehawken, N. J.

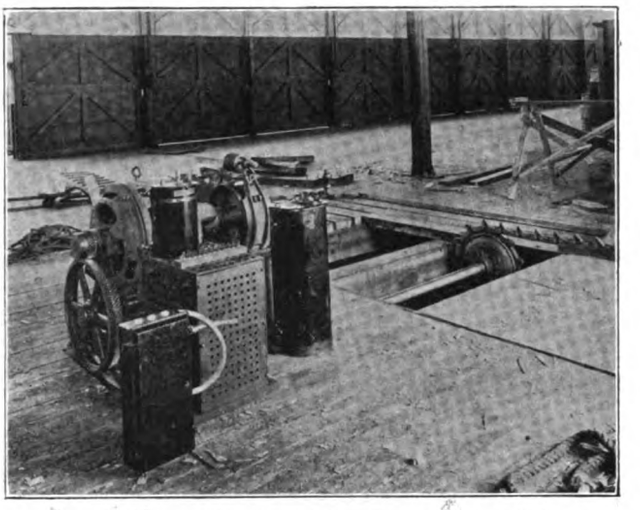

Fig. 2.—Motor, Controller and Reduction Gearing of Otis Inclined Elevator

At the Union Wharf of the Eastern Steamship Company in Boston, where three of these elevators are installed, a saving of fully 20 percent in the time required for unloading the vessels is made. The elevators are operated only when, on account of tidal and draft conditions, the gangways are at an inclination, and it is estimated that the three machines carry 125 tons of freight per hour during a period of five hours each day at a cost for power of one-sixth of a cent per ton, reducing the time of discharging the vessels from 15 to 20 percent. At another installation it has been authoritatively stated that the inclined elevators have saved 9 cents (0/4½) in the transfer of every ton of freight handled, the cost of power in this case being only one-tenth of a cent per ton.

The Merchants & Miners Transportation Company, which has two of these machines at its Savannah terminal, four at its Mystic Wharf terminal in Boston, and six at its new city terminal in South Boston, estimates savings of 13 to 15 percent in the cost of handling freight by the inclined elevators, while at the Weehawken piers of the New York Central & Hudson River Railroad the labor cost is reduced from 2 to 3 cents (0/1 to 0/1½) per ton, and the time for unloading is decreased so that the capacity of the marine equipment is increased from 20 to 40 percent, depending upon conditions. Also at both the New York and Norfolk terminals of the Old Dominion Steamship Company, inclined elevators have saved the labor of about four longshoremen for periods of about five hours per day. Similar savings have been effected by the installation of inclined elevators at other marine terminals, and they have also been of great benefit in conveying hand trucks from the first to the second story of pier sheds and warehouses.

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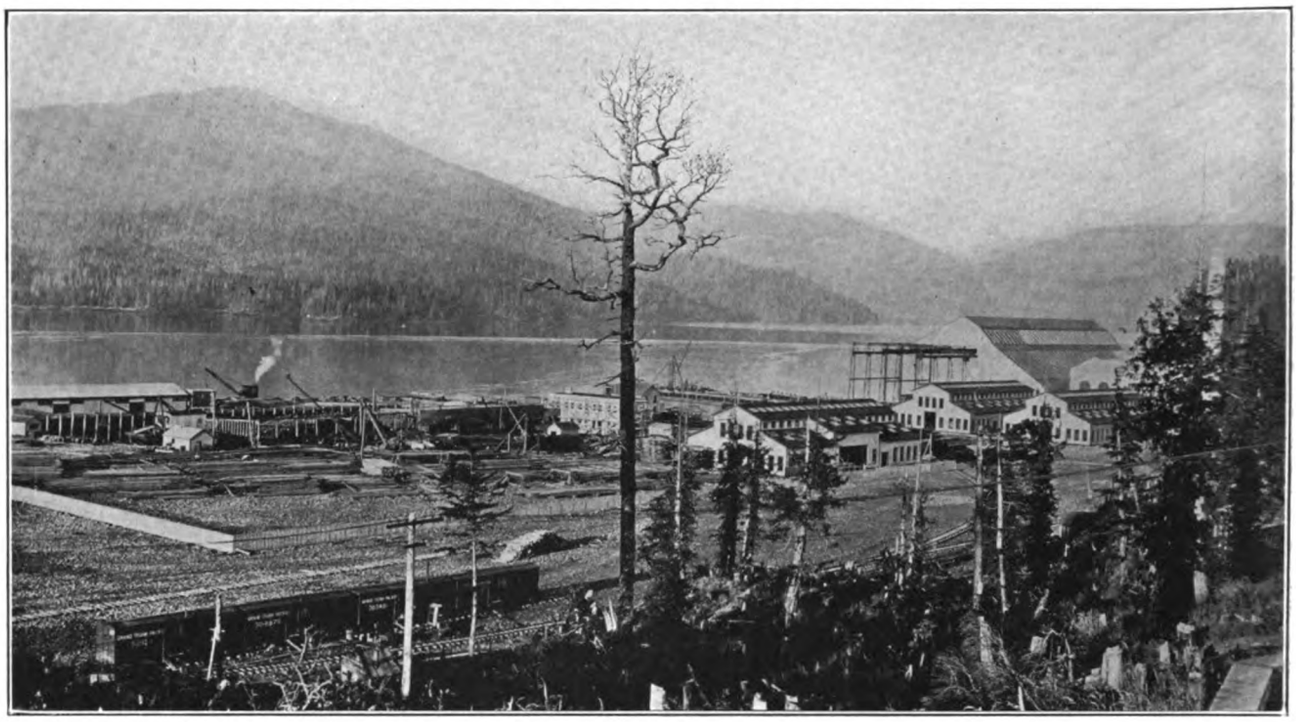

Fig. 1.—General View of Shipyard at Grand Trunk Terminal, Prince Rupert, B. C.

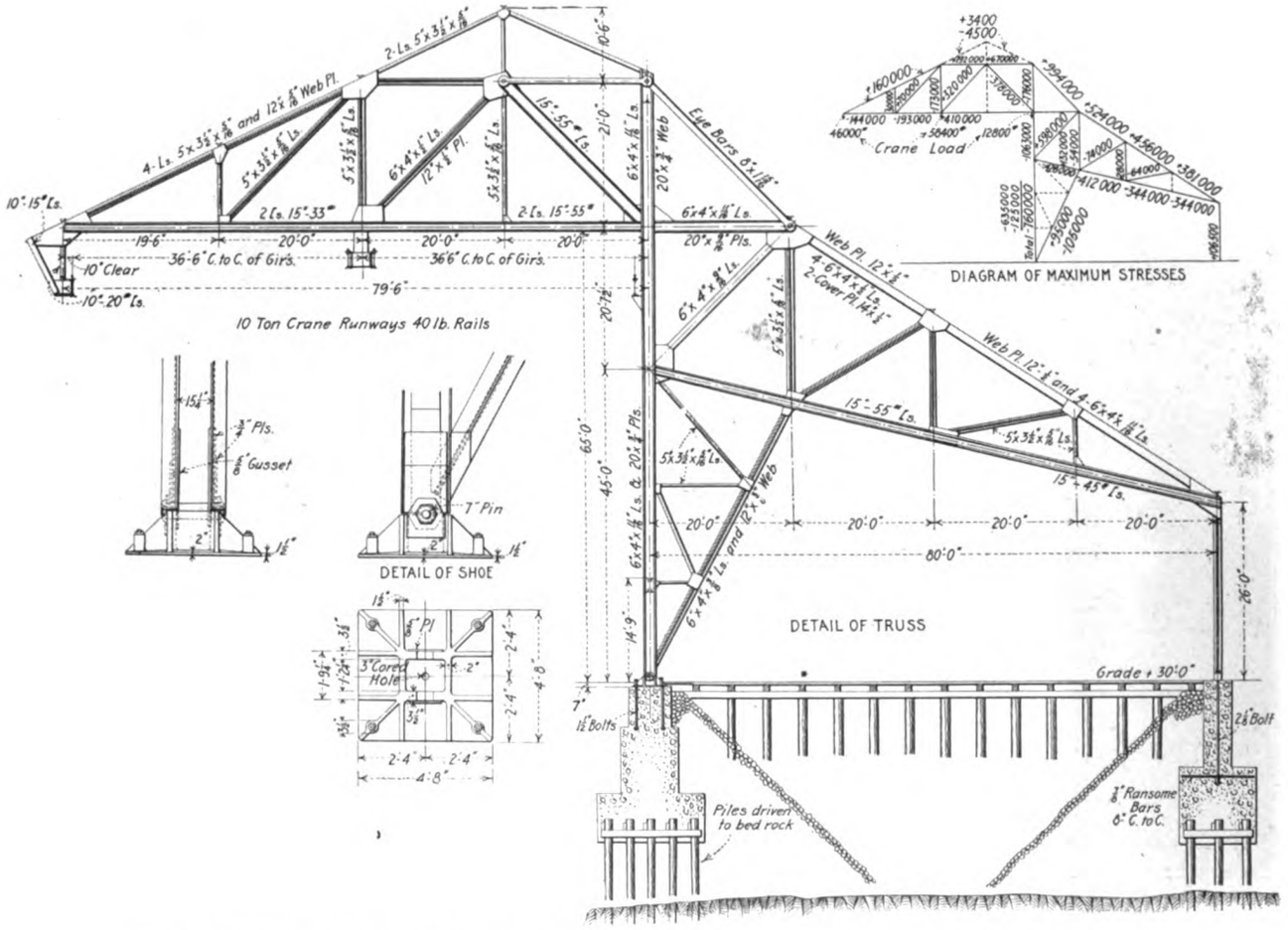

Fig. 2.—Structural Framing of Shipbuilding Shed, with Sketch Showing Maximum Stresses on Structural Members

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Shipyard at Prince Rupert Terminal

Unusual Structure Erected in Connection with Drydock and Repair Plant at Prince Rupert, B. C., for the Grand Trunk Railroad

BY WILLIAM T. DONNELLY *

While the climate at Prince Rupert is mild to such a degree that it is possible to do outdoor work all the year round, there is so much rain that it is most desirable to work under cover, and the building illustrated has been designed and constructed to meet these conditions.

The building is 300 feet long by 160 feet wide. The entire weight of the structure is carried on the center line of foundations. One-half of the roof is carried as an overhang, and besides supporting its own weight carries two 10-ton overhead traveling cranes. It will be noticed that at one end of the building there is a steel lattice work constructed to carry these cranes beyond the building proper for the purpose of taking material direct from the cars or from the wharf and placing it upon the work under construction.

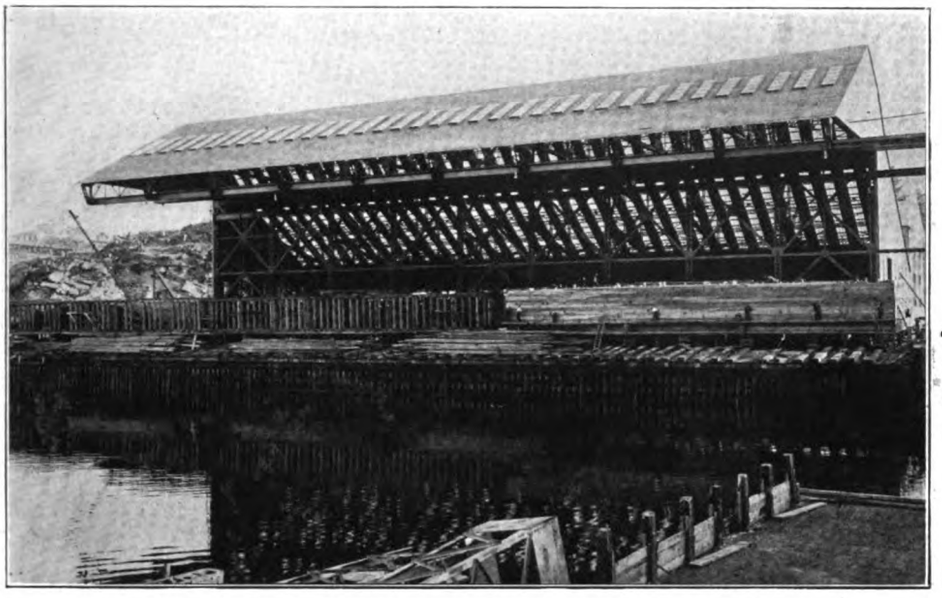

Fig. 3.—Covered Shipbuilding Berth Arranged for Side Launching of Vessels

The flooring under the overhanging portion is carried on very heavy piling, as will be seen by reference to Fig. 3. The outer 40 feet slopes 2¼ inches to the foot and serves as launching ways for side launching of vessels. When completed there is a clear height under the

* Consulting Engineer, 17 Battery Place, New York.

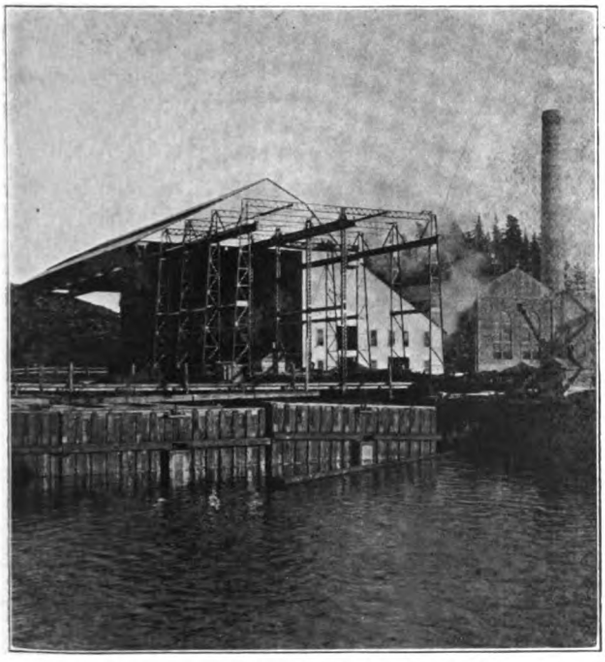

Fig. 4.—End View of Shipbuilding Shed

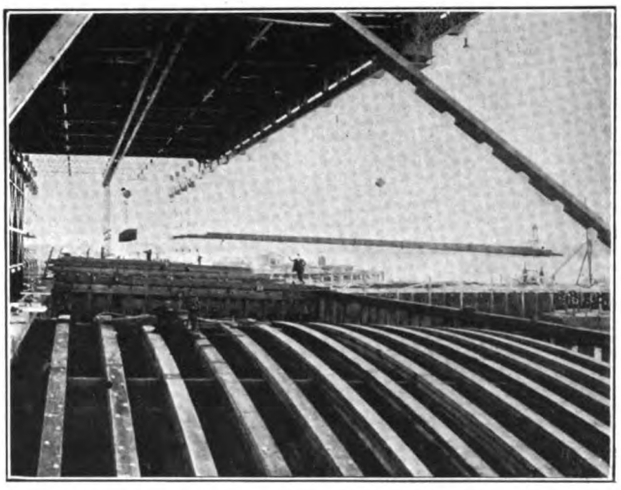

Fig. 5.—View in Shed. Dock Pontoons Under Construction

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overhead cranes of 65 feet and a clear length under cover of 300 feet, made up of nine spans 33 feet 4 inches on centers. This building was primarily designed and is now being used for the building of twelve pontoons for the 20,000-ton floating drydock, which will form an important part of this repair yard. Six of these pontoons have been completed and launched and three more are now being constructed under the shed.

The covered-in portion of the building in the rear of the building berth is used for wook-working tools and is equipped with the very latest and most up-to-date woodworking machinery. An upper floor over this portion is 300 feet long by 80 feet wide in the clear, without supports, giving a very fine floor for laying out ships.

By reference to Fig. 2, it will be seen that the center line of the columns on 33 feet 4 inch centers are carried on concrete foundations, some of which go to rock while others are carried on piles. To guard against the possible yielding of any single foundation, a vertical truss was worked in, connecting these columns, of sufficient strength to distribute the weight from any single foundation to the two adjoining. Very heavy wind bracing was introduced to resist unusually severe weather conditions. The weight of the overhanging portion with the addition of the load made it necessary to provide heavy concrete bases for the rear columns, or, in other words, under extreme conditions more than the total weight of the building is carried on the center foundations.

While side launching as provided for by this construction is unusual on the Pacific Coast, it is the rule on the Great Lakes and has been introduced at Los Angeles by a shipbuilder coming from the Great Lakes. The design of this building originated with Mr. Frank E. Kirby, well known in shipping on the Great Lakes.

Some of the photographs show how the building is now being utilized for building pontoons, and it has now been in use a sufficient time to fully test and demonstrate the utility and practicability of the general plan. At the present time there are being used on three pontoons building under this shed 28 air tools. These are used for boring, driving of spike and rods and for calking finished pontoons. Compressed air is furnished from a steam-driven air compressor with a capacity of 1,500 cubic feet of free air per minute at a pressure of 100 pounds. This machine, besides furnishing air for building the pontoons, is also driving riveters for the steel erection of the wings of the first section of the floating drydock and for tank work on adjoining property of the Imperial Oil Company.

The twelve pontoons which are to provide the lifting power for the 20,000-ton dock will contain 4,000,000 feet of lumber, and with the tool facilities and advantages of the overhead traveling crane it is possible to launch one of these pontoons every month.

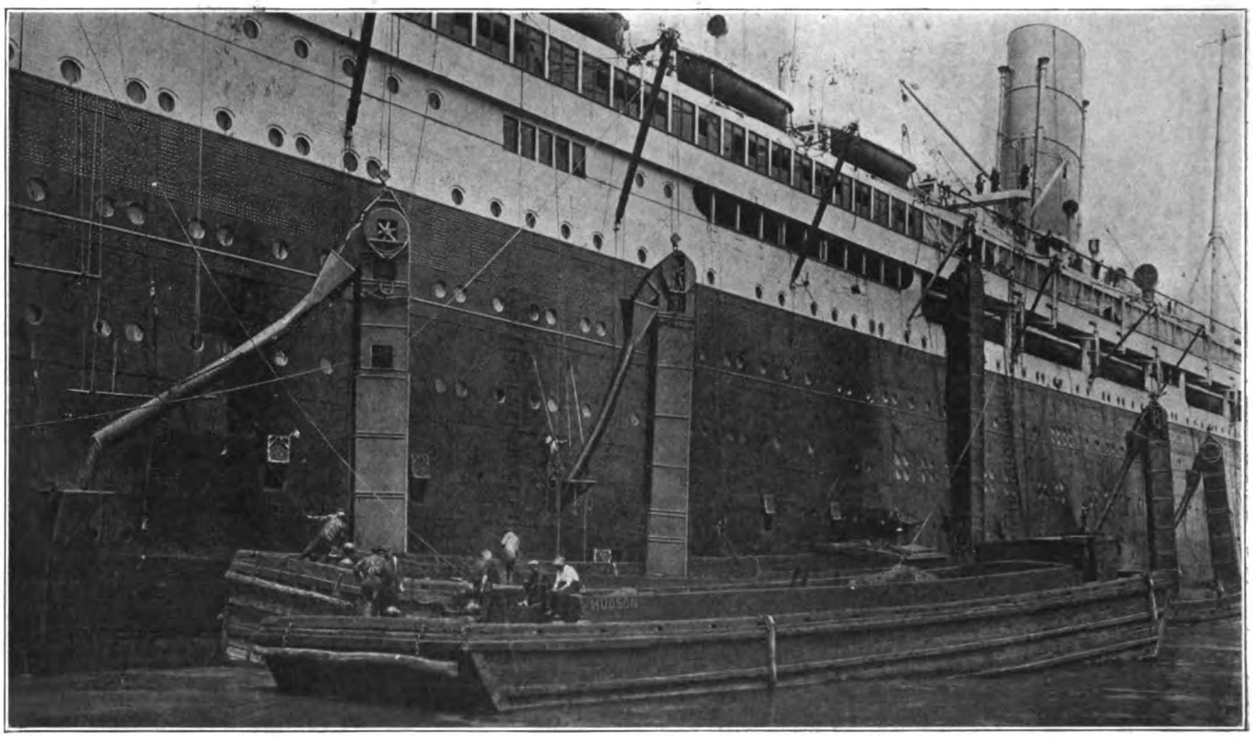

Fig. 1.—Coaling the *Imperator* with De Mayo Elevators; 8,200 Tons of Coal Placed in the Bunkers in 19 Hours

The De Mayo System for Coaling Ships

The present tendency toward greater bunker capacities in ocean liners, and shorter periods in port, has created the necessity for an apparatus which will reduce the time required for coaling vessels and which will require less space, cut down the labor and maintenance costs and eliminate the nuisance of flying coal dirt. When this need was first felt, some ten years ago, a portable elevator was developed, which, when suspended from a swinging boom at the side of a steamship and operated by electricity, was capable of discharging from a barge alongside 75 to 100 tons of coal per hour directly into the bunkers of the ship. By using a number of these machines on each side of the vessel it has now become possible to fill the bunkers of a modern leviathan like the *Imperator* with 8,200 tons of coal in the short space of only nineteen hours.

The machine that has made such a performance possible is known as the De Mayo portable elevator, and has been placed on the market by the Hudson Machinery

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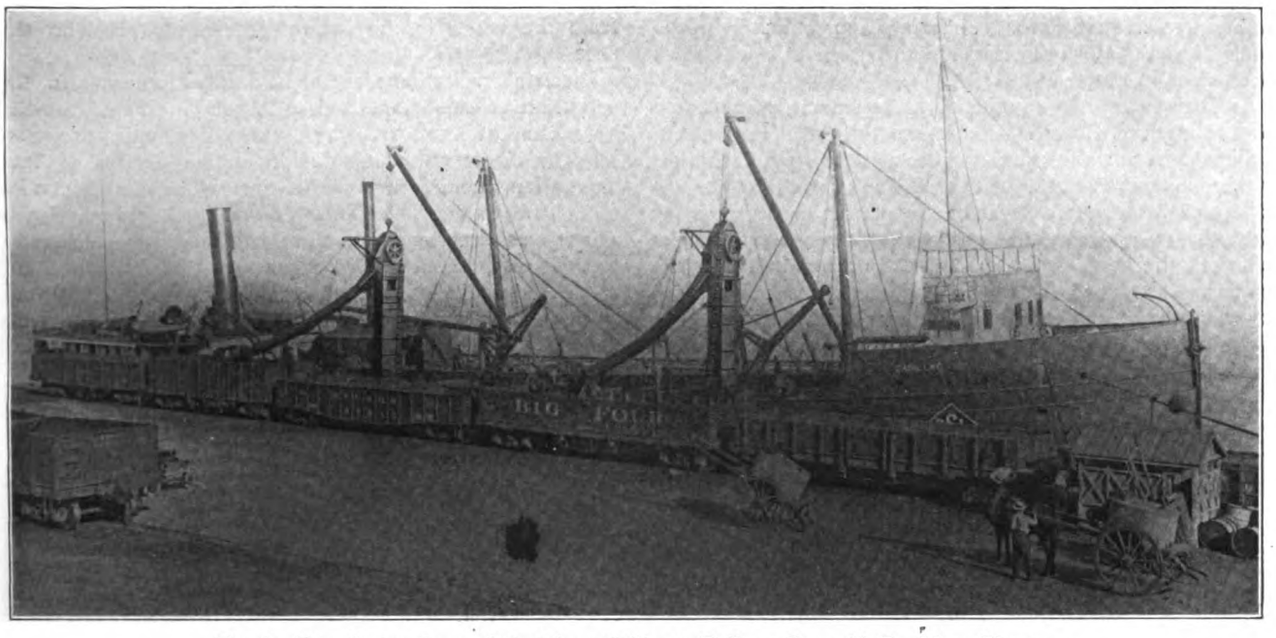

Fig. 2.—Transferring Cargo of Coal from Collier to Railway Cars with De Mayo Elevators

Company, New York. It consists of a steel frame, housed in to prevent the flying of coal dust, at the top and bottom of which are steel drums over which an endless belt of steel buckets is driven by an electric motor installed in the head of the elevator. The machine digs into the coal automatically under its own weight, and as the coal is carried up to the top of the elevator by the endless belt of buckets it is discharged into a telescopic chute through which it is conveyed by gravity directly to the ship's coaling ports.

The construction of the machine is simple. Its fundamental feature consists of the elimination of all chains. The steel bucket plates and the steel spacer plates that separate them are hinged together by steel pins, thus forming an endless belt which enables the machine to dig in heavy material without danger of breakdowns. The machines are entirely self-contained and may be suspended from a cable attached to a swinging boom. On the smaller sizes a power-driven winch is attached to the frame of the elevator which raises and lowers the machine. An attendant is required only to swing the machine about and to aid in "cleaning up."

The illustrations show some of the applications of this machine to the coaling of ships in New York harbor. In the case of the *Imperator* (Fig. 1), when in service this vessel lies in port but two days, of which only twenty-four

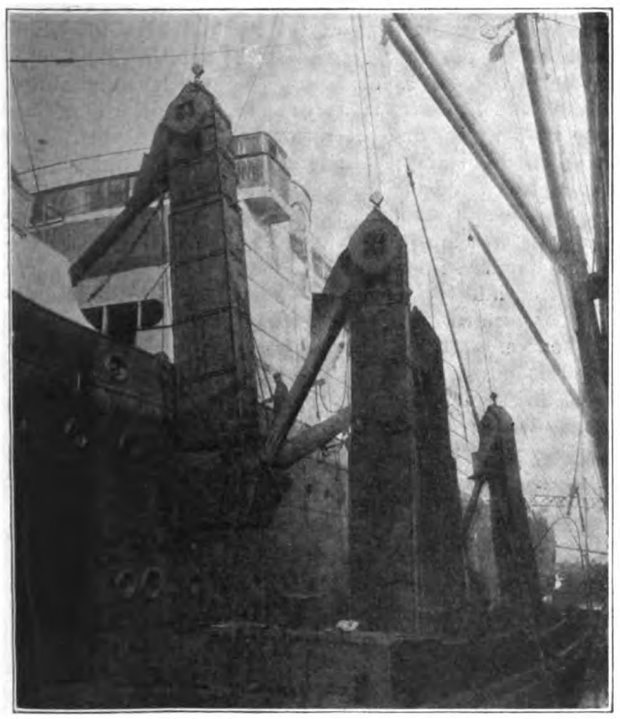

Fig. 3.—Tandem Arrangement of De Mayo Elevators Used in Coaling the *Cincinnati*

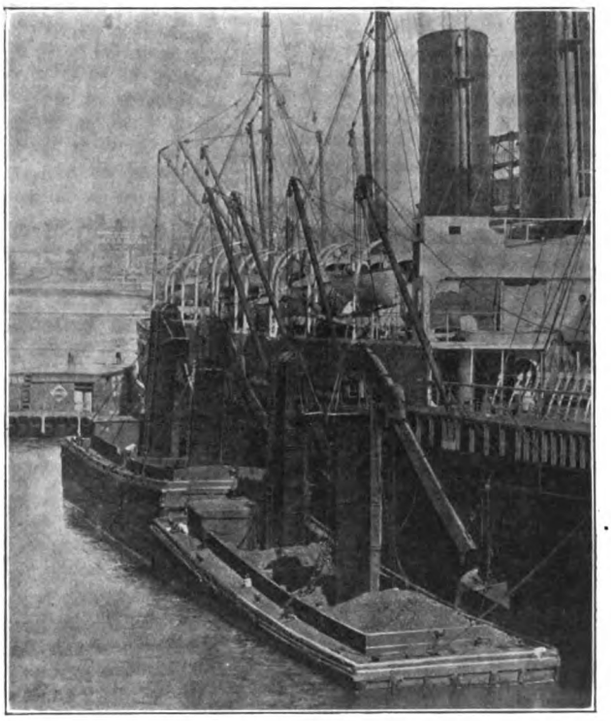

Fig. 4.—Coaling the American Liner *New York* at Pier 62, North River

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hours are available for bunkering approximately 8,200 tons of coal. With the De Mayo system this work has been done in nineteen hours.

In Fig. 3 is shown an unusual arrangement, necessitated in coaling the Hamburg-American liner *Cincinnati*. In order to reach the forward deck hatch two machines were coupled together, tandem fashion, bridging the exceptional height in two steps. A boot was constructed for the upper elevator, into which the lower elevator discharged the coal. Two machines working in the barge were used to feed the upper machine, thus showing the overload capacity of this type of machine.

Aside from its usefulness in coaling ships, this machine is equally applicable for use in unloading stone, crushed rock, sand, gravel, grain or any bulk material from cars, drays or other conveyances, as well as from barges, steam vessels and other craft. Its capacity, portability and low operating costs make it an important accessory to terminal facilities. The power required varies from 5 horsepower in the smaller unloaders to 10 horsepower in the 75-ton-capacity elevators.

Economy Gained by Handling Freight with Electric Trucks at Marine Terminals

At one of the steamship piers on the New York waterfront, where a number of electric trucks manufactured by the Elwell-Parker Electric Company, Cleveland, Ohio, have been installed to increase the economy of handling freight, observations covering a period of thirty days have shown that the cost of handling freight by electric trucks, including all items, such as labor, power, maintenance, insurance, amortization, etc., amounted to only 10.41 cents (0/5¼) per ton, as against 25 cents (1/0½) per ton for hand trucking.

The items of cost were as follows:

Labor	$0.087
Power	0.0039
Maintenance	0.0033
Investment, depreciation, etc.	0.0099
Total	$0.1041

In another case, at the Lehigh Valley terminal at Buffalo, N. Y., the following results were obtained:

Total trucks in service	38
Cost, including maintenance and supplies, vessels to cars	0.1923
Hand trucks (various commodities)	0.3100
Electric trucks—from cars to vessels	0.2115
Hand trucks—from cars to vessels	0.3100
Electric trucks—from platforms to cars	0.1138
Hand trucks—from platforms to cars	0.1600

Other reductions can be made in this latter item when operations are not interfered with by congestion due to car shortages.

Trucks have been used in every branch of the work, and with the exception of handling heavy structural iron, such as long beams, etc., from the floor of the house to the vessel, they are far superior to hand-truck operation. Their use in handling this long material from the floor to the vessel is restricted by reason of the construction of the vessel.

A substantial increase in the efficiency of the electric trucks can be obtained by increasing the sling loads from the steamer, or proper assembling of sling loads in the hold of the vessel would greatly enhance the capacity of the electric truck operation by permitting proper draft from the vessel to the car or distributing point on the floor.

Electric trucks have shown a decided economy in the operation at this plant and a largely increased facility by reason of more freeway. Other economies are possible by direct unloading during certain periods of lake navigation, from cars to vessel, instead of double-handed from cars to floor and floor to vessel. Further, no difficulty was experienced in the operation of the trucks by the laborers, as they were eager to act as operators and required but little instruction to become efficient in this work. As a matter of fact, both the employee and the employer can benefit materially by the adoption of electric

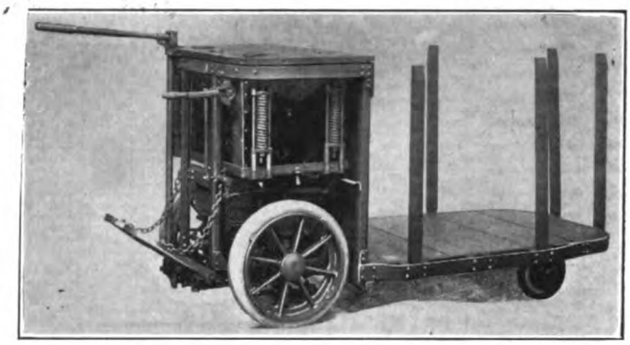

Fig. 1.—Elwell-Parker Freight Truck

trucks, as with the old method of hand trucking the men are paid at a flat daily rate, whereas by using the electric truck and working on a tonnage basis the employee is able to increase his compensation in some cases by as much as 20 percent.

ELWELL-PARKER TRUCK

The electric freight truck (Fig. 1), manufactured by the Elwell-Parker Electric Company, Cleveland, Ohio, is of peculiar design, which enables it to enter narrow spaces and to be handled with ease on a platform or in a warehouse. As the platform of the truck is very low to the ground it is particularly well suited for the handling of heavy freight in small bulk. The truck weighs 1,900 pounds and has a capacity of 4,000 pounds. The wheel base is 53 inches and the turning radius 6½ feet. Some of its distinguishing features are automatic control, automatic brakes and the four-wheel steer.

The operator stands upright on a small platform, operating the steering lever with his right hand and the controller handle with his left hand. The operating platform is divided into two halves. The left half, or switch platform, is located on the same side as the controller handle and operates the automatic switch or circuit breaker, which is closed as long as the operator stands on the platform, but which automatically opens when the operator steps off the platform. The right half, or brake platform, which is controlled by the operator's right foot, automatically applies the brakes when his foot is raised or when he jumps off the truck. In this way accidents and emergencies are provided against, as by jumping off the truck the operator automatically shuts off the power and applies the brakes, bringing the machine to a stop almost instantly.

The two sets of wheels are so arranged that both the rear and the front wheels automatically take the same radius of curve and all four wheels are controlled by the one steering lever. This feature permits operation in narrow aisle spaces and under congested conditions, reducing the space required for turning to a minimum.

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The motor is mounted under the platform and is direct-connected to a worm gear and the power is transmitted through a differential to the hubs of the two rear wheels by utilizing a special universal connection. Either lead or Edison-type batteries may be used. On account of its low platform the type of truck shown in Fig. 1 is particularly adapted for loading heavy packages, such as barrels of oil, sugar, etc.

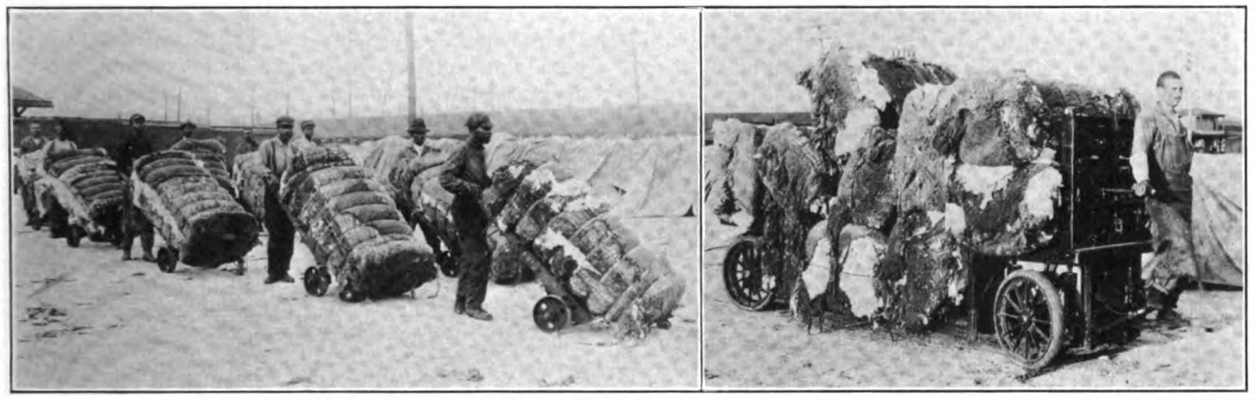
APPLICATION OF ELECTRIC TRUCKS AT TERMINALS

Figs. 2 and 3 show how one drop-frame electric truck with one man does the work of ten hand trucks and ten men. These views were taken while the trucks were handling cotton for the Central of Georgia railroad at Savannah, Ga. Throughout the South at the great ports where such trucks are used the cost of handling cotton is being lowered anywhere from 50 to 75 percent, depending upon the distance of haul, loading facilities and like conditions.

Fig. 4 shows a special type of tractor carrying various miscellaneous loads in trailers. In a great many cases the trucks and trailers are designed for some particular work because of the varying conditions of operation. In narrow, restricted passages with sharp turns, it is usual to have all four wheels actuated by the steering mechanism. In the case shown in Fig. 4 the tractor replaces twenty-one men.

At the Savannah terminal of the Ocean Steamship Company, where electric trucks are employed for loading cotton, and the round trip from the point of loading to the vessel amounted to 2,500 feet, it was found that one man with a hand truck made the round trip in 24 minutes, while an electric truck, replacing ten men and ten hand trucks, made the round trip in 9 minutes, thus showing the possibilities in saving time and thereby increasing the all-around efficiency and economy.

Fig. 5 is a view taken at Port McNicoll, Ontario, Canada, on the Canadian Pacific. The truck shown carries 52 sacks of export flour, as compared with 5 sacks on hand trucks. In loading trucks direct from the hatch of a vessel it has been necessary to increase the capacity of the sling to lift one truck load of sacks from the hold onto the truck in one operation, thus facilitating quicker loading and unloading.



Figs. 2 and 3.—One Man with Electric Truck Replaces Ten Men with Ten Hand Trucks

While the foregoing are only a few of the many instances that might be cited to show the savings in time and money that are possible in handling freight by electric trucks in place of hand trucks, nevertheless they are sufficient to show the possibilities that can be realized by introducing such methods at marine terminals.

The immense increase in the volume of freight now being handled through marine terminals demands a proportionate increase in the efficiency of its handling. Old methods involving slow and expensive movements of freight must give way to high speed, power appliances of large capacity by which both the cost and time of handling can be materially reduced. The same problems are being faced at railway terminals and in great industrial plants, and many of the methods that are proving successful in such cases can be adopted profitably at marine terminals.

Fig. 4.—Special Tractor Replacing Twenty-one Men

Fig. 5.—Fifty-two Sacks in One Load on Electric Truck

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Lumber Operations on the Atlantic Coast

Modern Lumber Steamer and Complete Terminals Under Construction for Shipping Lumber from Florida to New York

To all those interested in lumber and its distribution, and to all concerned in shipping, a description of the lumber operations of the Carpenter, O'Brien Company on the Atlantic coast will be of special interest. It has been assumed by many that the timber adjacent to the Atlantic seaboard has been so depleted that the Pacific coast must be looked to for a supply. While this may be the case in so far as the larger sizes are concerned, it does not apply to the sizes and qualities forming the great bulk of the lumber used on the Atlantic coast. As a matter of fact, during the spring of this year the Carpenter, O'Brien Company, of New York, will be ready to furnish the wholesale market with all grades of the finest Southern long leaf yellow pine and cypress, manufactured in every

able to the end of avoiding delays to their proposed vessels, of securing economy in handling their cargoes in and out and avoiding damage by bruising, breakage or moisture to the lumber in transit, and more particularly to the finer qualities of lumber and dry kiln stock.

The mill products, without exception, will be handled in units 4 feet square varying in length, each unit having two special iron binders to which the crane hooks are attached when hoisting or lowering. They will be brought from the mill to the shipping wharf by monorail conveyors, and will then be stacked on the wharf according to lengths by overhead traveling gantry cranes. The general arrangement of the shipping wharfs at both the New York and Jacksonville terminals is shown in Fig. 1. The

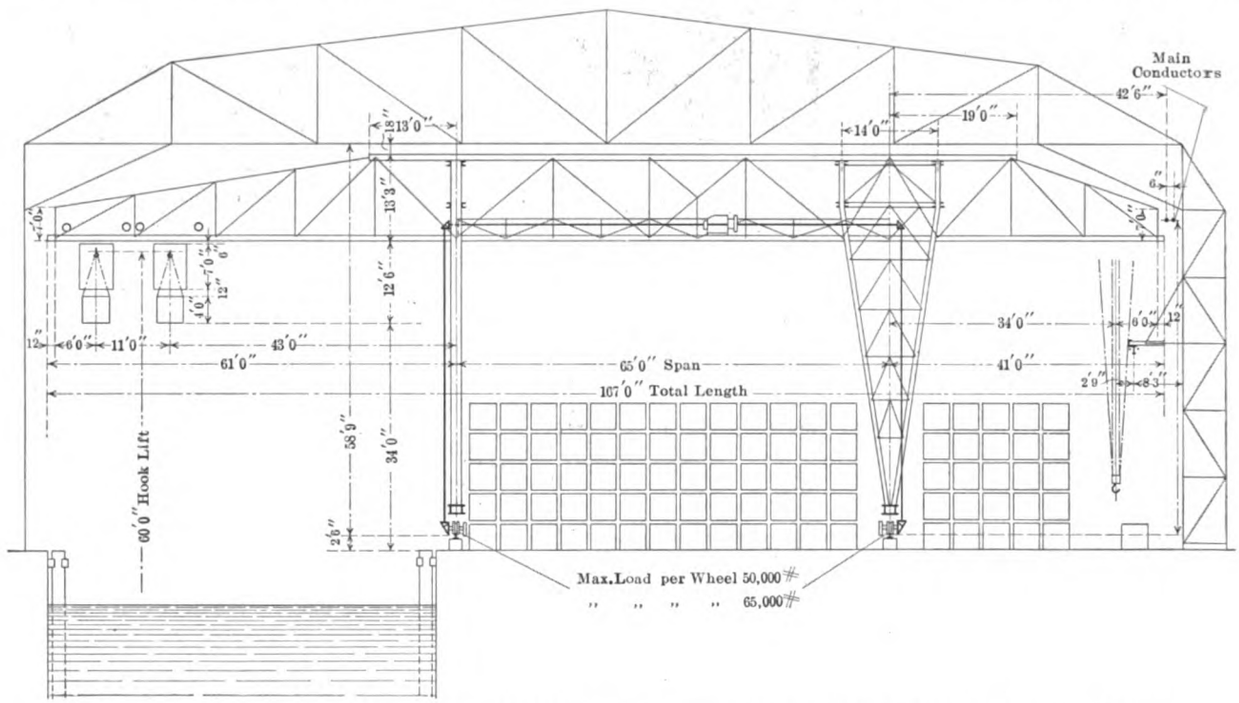

Fig. 1.—General Arrangement of Shipping Wharfs Building at Jacksonville, Fla., and New York for the Carpenter, O'Brien Company

form ready for use, all of which will be transported by water from Jacksonville, Fla., to the central depot at New York. New mills are now being constructed by this company at Jacksonville in conjunction with sheds, wharfs and various types of machinery for the rapid handling of lumber on a system that is quite new. There is also a terminal yard in New York harbor, which is also fitted up with rapid unloading devices and storage sheds.

It is a fact well recognized by shipowners that short trips and long lays in port form an expensive service. A vessel must be looked upon as a conveyor and should not be used as a warehouse. Any time that a cargo vessel may be at a wharf over and above that essential for loading or unloading by the most efficient means that can be devised is a dead loss to somebody. Invariably this loss becomes a charge on the merchandise, thereby increasing the cost unnecessarily or depriving the merchants of a further possible profit. Before deciding on their plant, therefore, the officers of the Carpenter, O'Brien Company carefully considered every plan avail-

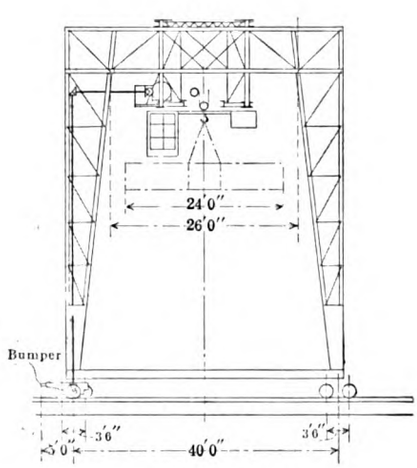

Fig. 2.—End View of Gantry

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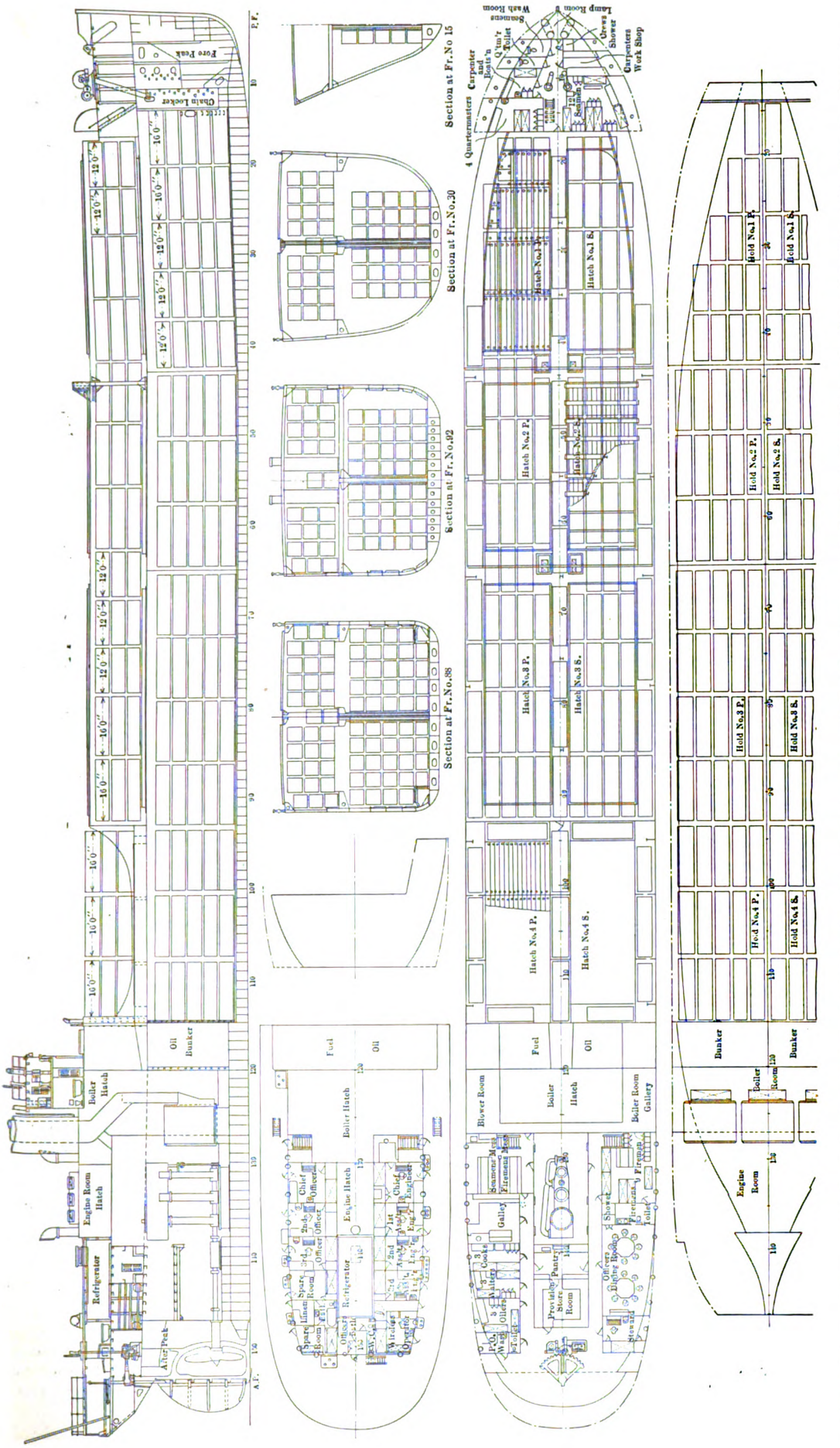

Fig. 3.—General Arrangement Plans of Lumber Steamer *William O'Brien*, Built by the New York Shipbuilding Company, Camden, N. J., from Designs by Edward S. Hough, San Francisco, Cal., for the Carpenter, O'Brien Company

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gantries run from end to end of the wharf, spanning the slip. Each gantry has two trolleys having a run the full length of the bridge. The two right angle motions allow every part of the storage space on the wharf and on the ships to be reached by the crane hook. Stevedoring in this case is eliminated.

Turning now to the vessels that will carry the lumber between the terminals, the first of the vessels designed for this service is the *William O'Brien,* shown in Fig. 3, which was designed by Edward S. Hough, naval architect, of San Francisco, Cal. This vessel is designed along the lines of the steamer *Adeline Smith,* the first of the kind, a description of which was published in this journal some months ago. The *William O'Brien* is designed to carry 3,000,000 feet board measure on the unit system. If the lumber were stowed in the usual manner the vessel would carry about 4,000,000 feet. It will be noticed from the drawings that the holds and deck spaces are all arranged in multiples of two and that suitable sparring and shelving is provided so that the units will stow square.

The principal dimensions of the vessel are as follows: Length between perpendiculars, 360 feet; breadth molded, 51 feet; depth molded, 27 feet.

There is a solid plate centerline bulkhead running from the forepeak to the fireroom bulkhead, suitably stiffened to take the place of hold pillars. Hold 2 is used as a deep ballast tank when the ship is light. The hatches are all of such size that the cargo is lowered into place and lifted out without any rehandling or hauling about in the holds. The whole cargo of 3,000,0000 feet will be loaded in one day at the Jacksonville plant and will be discharged in one day at the New York terminal. The vessel will, therefore, become a "conveyor" in the true sense of the word.

The details of the vessel have been worked out with a full knowledge, based on experience, of what a continuous service involves. The boiler capacity is more than ample. Three boilers have been provided in place of the customary two units. Should repairs become necessary to one boiler, there still remains two-thirds of the boiler capacity, which is sufficient to operate the ship. Had she but one boiler under the same conditions, delays would occur, as one boiler would be insufficient to operate the ship at the required speed. The boilers will be oil-fired and the fuel oil will be carried in the athwartship bunkers.

All of the machinery has been provided for along the same lines; ample strength and bearing surfaces are found and the auxiliary machinery is largely interchangeable and readily duplicated. There is one triple expansion engine with cylinders 24¼ inches, 38½ inches and 67 inches diameter by 45 inches stroke. An air pump, two feed and two bilge pumps are driven off the intermediate cylinder crosshead. The condenser has about 3,300 square feet of cooling surface. All of the independent pumps are of the Blake type, with the exception of the ballast pump, which is a De Laval single stage, double suction centrifugal pump, driven by a two-stage De Laval steam turbine. Propulsion is by a four-bladed propeller, 16 feet 6 inches diameter, 13 feet 10 13/16 inches true pitch, with a projected area of 62.65 square feet and a developed area of 70.96 square feet.

No cargo-handling gear is provided on the vessel other than the forward hoist, and this is only for occasional use.

In addition to the steamer described above, the company has in course of construction a fleet of lumber delivery barges, each provided with a revolving luffing steam crane. The barges will go into the steamer's slip at the terminal and will be loaded by the gantrys. They will be towed by the company's own tugs to the various wholesale lumber yards about the harbor, and the lumber will finally be delivered by the steam cranes into the yards in the original binders as made up at the mills.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

	Tons.	Knots.		1914. Nov. 1.	1915. Feb. 1.
BATTLESHIPS					
Nevada	28,000	20½	Fore River Shipbuilding Co..	77.8	84.6
Oklahoma ..	28,000	20½	New York Shipbuilding Co..	79.3	87.2
Pennsylvania	31,400	21	Newport News Shipb'ding Co.	58.3	67.1
Arizona	31,400	21	Navy Yard, New York.....	36.8	48.1
Mississippi ..	32,000	21	Newport News Shipb'ding Co.	00.0	6.0
Idaho	32,000	21	New York Shipbuilding Co...	00.0	9.9
TORPEDO BOAT DESTROYERS					
Downes	1,010	29	New York Shipbuilding Co...	95.3	99.2
O'Brien	1,050	29	Wm. Cramp & Sons.....	88.4	93.3
Nicholson ..	1,050	29	Wm. Cramp & Sons.....	86.5	90.2
Winslow ...	1,050	29	Wm. Cramp & Sons.....	82.3	87.0
Cushing	1,050	29	Fore River Shipbuilding Co..	73.7	84.0
Ericsson	1,050	29	New York Shipbuilding Co...	87.4	92.8
Tucker	1,090	29½	Fore River Shipbuilding Co..	18.8	33.2
Conyngham..	1,090	29½	Wm. Cramp & Sons.....	39.5	54.3
Porter	1,090	29½	Wm. Cramp & Sons.....	29.5	50.8
Wadsworth..	1,090	29½	Bath Iron Works.....	66.4	78.6
Jacob Jones.	1,090	29½	New York Shipbuilding Co...	33.7	52.2
Wainwright..	1,090	29½	New York Shipbuilding Co...	33.4	51.7
No. 63.....	1,090	29½	Fore River Shipbuilding Co..	00.0	6.4
No. 64.....	1,090	29½	Fore River Shipbuilding Co..	00.0	6.4
SUBMARINE TORPEDO BOATS					
G-2	....	....	Navy Yard, New York.....	89.7	89.7
G-3	....	....	Navy Yard, New York.....	85.7	86.7
K-7	....	....	Union Iron Works.....	98.1	100.0
K-8	....	....	Union Iron Works.....	98.1	100.0
L-1	....	....	Fore River Shipbuilding Co..	67.4	89.6
L-2	....	....	Fore River Shipbuilding Co..	66.2	84.6
L-3	....	....	Fore River Shipbuilding Co..	66.1	75.5
L-4	....	....	Fore River Shipbuilding Co..	65.7	76.0
L-5	....	....	Lake T. B. Co.....	41.2	58.2
L-6	....	....	Lake T. B. Co. (Long Beach, Cal.)	41.7	52.7
L-7	....	....	Lake T. B. Co. (Long Beach, Cal.)	39.7	51.6
M-1	....	....	Fore River Shipbuilding Co..	50.6	63.4
L-8	....	....	Navy Yard, P'tsmouth, N. H.	0.0	3.0
L-9	....	....	Fore River Shipbuilding Co..	24.9	50.0
L-10	....	....	Fore River Shipbuilding Co..	23.8	45.6
L-11	....	....	Fore River Shipbuilding Co..	0.0	3.2

Reasons for Advocating Electrical Propulsion

While there has been considerable skepticism on the part of marine engineers as to the successful application of electricity to the propulsion of ships, this has been due principally to the unfamiliarity of marine engineers with the handling of large units of electrical machinery operating at high voltage. The direct-connected steam engine, especially of the reciprocating type, is an old and tried friend. Every marine engineer has been shipmates with this type of machinery from the time when he first went to sea. He is thoroughly familiar with its characteristics and capabilities and is fully prepared to meet any emergency that may arise. This knowledge has inspired in himself confidence in his own powers as master of the powerful machinery under his control, and the introduction of a new and unfamiliar type of machinery is naturally not met with favor on his part. The experience gained from the *Jupiter,* however, has shown that the burdens of the engine-room staff are materially lightened on an electrically propelled vessel. In place of the heavy throttles that must be opened and closed there are light, easily-handled oil switches and a speed controller that can be handled with one finger. Fewer men are required on watch in the engine room and, in a rough sea, there is no racing of the machinery, with the consequent constant attention of the engine-room watch. The machinery responds promptly to changes of speed, and full power is available for backing, making the vessel particularly handy for maneuvering. With all these advantages in view it will probably not be a difficult task to win over the marine engineer to the ranks of the advocates of electrical propulsion.

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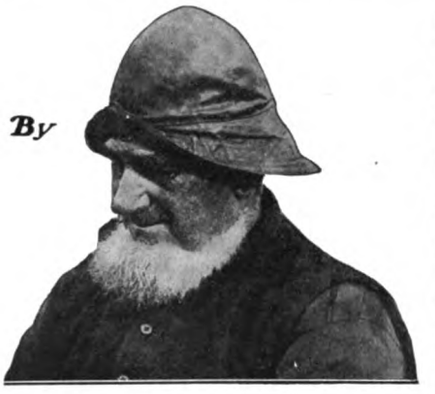
Economy Talks By "Old Scotch"



Lubrication

There is an old saying that there are more ways than one to kill a cat, and in this economy on shipboard there are more ways than those I have already written about to save money.

Next to fuel, probably the most expensive item in the operating expenses on board ship is lubricating oil, and on almost any big ship there are lots of ways of cutting down that expense. When I first went to sea we used nothing but hog grease, or lard oil, as they called it, and we had to pay from 90 cents (3/9) to $1.10 (4/7) a gallon for it; that was indeed some expense.

It was not only expensive, but it had other bad features. Those of you who have never smelled rotting lard oil in the bilges of a wooden steamer do not really know what perfume is. Besides that, if you had a burn or a cut on your hands or face, the smarting pain the use of lard oil would give you, on account of the salt, used to preserve it, was something to remember, and make you thank your stars that coal oil was discovered out in Pennsylvania before the most of you were born.

The fine grades of mineral oil you use these days at a cost of thirty to forty cents (1/3 to 1/8) a gallon are also something to be thankful for. Because it is much cheaper than lard oil used to be, is, however, no reason why it should be wasted. I'll venture to say that on almost any steamer running to-day a saving of from ten to fifty percent in oil bills can be made if the men in charge will go after the oilers who are responsible for the use of the lubricants.

If you really want to find out how little oil a marine engine can run on with safety, just get caught out at sea about a thousand miles from home some time, and find that owing to the gage glass on your oil tank being filled, with the gage cocks at top and bottom shut off, you thought you had twice as much oil on hand as you really had. That occurred to me one time, and I have no doubts but what the same experience has fallen to the lot of many other engineers. It kind of makes you feel sick to find that you have only two days' quantity of oil on hand when you thought you had at least enough for a week's run. The fact that I am sitting up writing this dope is evidence that we got into port, even if we did have such a small quantity of oil on hand

"How did we do it?" did I hear you say? Well, my boy, it was simply a case of economy applied strictly on the ground of necessity. We made every drop of oil count, and we got into port with about ten gallons of oil to spare.

The first thing I did was to call my assistants and all the oilers and read them the riot act about being careful with the oil. And believe me, they were careful, too. The first thing they did was to cut out all the automatic lubricators, which are at all times both a blessing and a curse. A blessing, because if an oiler loafs on his job the oil is sure to be fed to the working parts, and a curse, because the natural tendency is to let them run so strong to make doubly sure that all the journals get oiled that about twice as much is used as is really needed. By cutting out all those oil manifolds and oiling with a squirt can the quantity we used was at once reduced over a half. Of course, there were no unnecessary flourishes given the oil can, and every time an oil cup was aimed at the stream of oil came pretty near to hitting the bull's eye. Then, too, we dug up out of a storeroom a couple of old oil cans and rigged up a kind of filter whereby we could strain the oil caught in the drip pans through an old woolen undershirt, thus saving much of the oil to use over again on the engine.

It surprised all of us how little oil that old engine needed, as compared to the amount we had been giving her when we thought we had plenty of oil in the tanks. The next voyage we made we adopted the same tactics as we had been using in those few days of hard times, and if that old hooker is still running I'll bet that they are using that reduced amount yet.

That experience taught me a good lesson, and one that I have profited by ever since. With an ordinary automatic lubricator secured to the engine casing I usually cut out all the oil drips except the two to the crosshead pins on each cylinder, and make the oilers oil all the other journals by hand. Crankpins, if watched closely, can be oiled by hand entirely, although on some engines it is advisable to have a steady flow of oil from the lubricator. Nine times out of ten, though, unless you watch the drops yourself, the oiler will let it run too freely and waste about half as much as is put on.

Some engineers believe in using compound on small journals where there is little motion, and I believe there is economy in that. The great oil-users are the crosshead pins, crankpins, main bearings and the thrust. It is undoubtedly very economical to catch the oil from these journals in drip pans and strain it in a filter, of which there are several good types on the market. Oil can be used a number of times without losing its lubricating quality, and the main object of the filtration process is to remove any dirt from the oil.

Of course, we all know that there should be a certain amount of the waste oil run into the engine-room bilges, as there is nothing better to preserve the steel around the inaccessible parts of the engine foundation than oil sloshed around in the bilge water. I'm not altogether sure if it isn't a good idea to let some of the oil from the engine-room bilge run into the fireroom bilges through the sluice valves, as the Lord knows it is a pretty hard game to keep the hull plates and frames under the boilers from rusting out in these steel ships we are running.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT*

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

EDITOR'S NOTE.—In reply to a question on page 38 of the January, 1915, issue, regarding the use of jet condensers with turbines when fresh water is available for circulating water, the answer stated that jet condensers should never be used, as this type of condenser is unsuitable for the production of the high vacua essential to good efficiencies in turbine installations. In view of the fact that jet condensers with rotary pumps are used extensively in shore turbine installations, giving high vacua and good economy, it should be distinctly understood that the answer given in the January issue referred only to present ship practice, that is, to the type of marine jet condenser with reciprocating pumps in common use on fresh water. The answer as given is true for that type, but does not apply to jet condensers now common in shore turbine installations, which have pumps of the Leblanc, Thyssen or Delaporte types. These pumps are valveless rotating pumps that draw air out of the condenser by entraining it between pellets of water or in a jet discharged at high velocity into the pipe from the condenser. Pumps of this sort will handle a large volume of air and give vacua equal to those obtained with surface condensers.

Q.—How can I find the two-thirds power of a displacement? STUDENT.

A.—The easiest way is to square the number and then extract the cube root of this square. If a table of squares and cubes is available, it simply means leveling up the two entries in the table.

Q.—What is the largest Diesel engine installation in a ship at the present time? H. B. H.

A.—The largest total horsepower is in the *Fionia*, which has two 6-cylinder Diesel engines of 2,000 brake horsepower each. The largest horsepower per cylinder is a bit over 500.

Q.—How do you determine the number of expansions for a triple-expansion engine of known dimensions? S.

A.—The number of expansions in its commonly accepted significance is the ratio of the volume of the low-pressure cylinder to the volume of the high-pressure cylinder at the cutoff, clearances neglected.

Q.—Why are torsion-meters not used for determining the shaft horsepower of reciprocating engines? P. S. H.

A.—Torsion-meters are at their best when measuring the output from engines having a constant turning-moment or torque, as in the case of turbines, and even here the torsional oscillation of the shaft from the thrust-block to the propeller, caused by irregularities in propeller action, gives trouble. In the case of a reciprocating engine the torque is so irregular at different angles of rotation that torsion-meters give unsatisfactory results. There have been instances, however, of torsion-meter applications to reciprocating engines, but generally with poor results.

Q.—In reading the figures which are placed at the bow and stern for indicating the draft, should the figure be read to its top or bottom or centerline? DRAFT.

A.—Figures for draft read to the lowest point of the figure and are customarily six inches high, so that, if the water were half way up on 14, the draft would be 14 feet 3 inches, or, if just covering it, 14 feet 6 inches.

Q.—Will you please explain the following: In a triple-expansion condensing engine is the vacuum produced by the air pump effective only in the low-pressure cylinder, or does it cause a reduction of pressure below that of the atmosphere in the intermediate- and high-pressure cylinders as well? J. R. P.

A.—The vacuum affects the pressure in all cylinders, but most in the low-pressure cylinder, and least in the high-pressure cylinder. For the range of pressures customarily met with, the only cylinder in which the pressure falls below the atmospheric pressure is the low-pressure cylinder.

Q.—We have a 2,500 indicated horsepower, coal-burning freighter, with a radius of action of about 3,000 miles. How much of a saving in weight of fuel carried could be expected if oil-burning apparatus were installed? CHIEF.

A.—A moderate value of coal per indicated horsepower per hour for vessels of this character is from 1.6 to 1.8 pounds, so that for the time required to steam 3,000 miles (assuming a speed of 10 knots) would be about

$$\frac{1.8 \times 3{,}000 \times 2{,}500}{10 \times 2{,}240} = 603 \text{ tons.}$$

For oil fuel probably 1.1 pounds is a conservative figure, which would give 361 tons for the 3,000 miles, or a saving of 235 tons deadweight and the further saving in volume of the entire space now used for coal, as the oil fuel would probably be carried in the double bottom.

Q.—I have frequently of late seen references to the "Michell" thrust bearing, and judge that it is some new kind of thrust bearing for ships. Can you give me a brief description of it, and tell wherein it differs from the standard type in use? T. B.

A.—The principle of the "Michell" bearing is that of automatically forced lubrication. The thrust of the shaft is transmitted to the stationary part of the bearing through a series of sectors each supported at its center of pressure, which is two-thirds its length from the leading edge. When running, each block takes a slight tilt, and the space between it and the opposing collar is at the leading edge about twice that at the trailing edge. Oil enters and is forced along the narrowing channel, so that a film is always maintained between the surfaces. The theoretical work upon lubrication on which the practical design is based was derived by Osborne Reynolds in 1886, and the earliest patents were brought out by "Michell" in 1905. Since then there have been several thrust bearings of this same general character. One made in this country is the "Kingsbury" (patented 1910 and now installed on the U. S. collier *Neptune*). Bearings of this sort have been shown to withstand remarkable pressures. The normal type of thrust bearing is rarely designed to carry much over 50 pounds per square inch, and with turbines, where the pressure is steady, trouble was found

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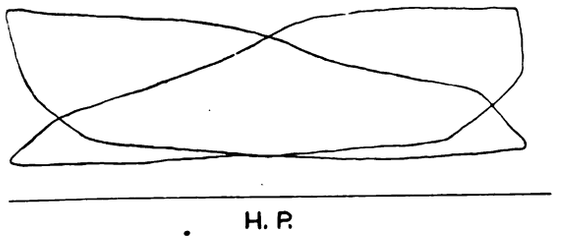
at even low pressures, due to the oil being squeezed out. Bearings of the "Michell" type are customarily designed to operate at thrusts of 500 pounds per square inch and often are operated as high as 1,500 pounds per square inch. In fact, in an experimental bearing of the "Kingsbury" type, made by the Westinghouse Company, pressures up to 10,000 pounds per square inch were attained with no heating, although at this pressure the white metal was squeezed out and the pressure had to be reduced. The friction losses in a bearing of this sort are about 1/15 of those in a standard bearing and but one thrust collar is customary.

Q.—Inclosed are indicator cards taken from the engines of one of the Japanese trans-Pacific Ocean liners. Will you please explain the cause of the defects in the low-pressure cards, and how they can be remedied? S. M.

A.—The high- and intermediate-pressure cards and the top card of the low-pressure cylinder need no comment. The abnormalities apparent in the card from the bottom



Cards from Four-Cylinder, Triple-Expansion Engine

end of the low-pressure cylinder can be explained by an insufficiently opened indicator cock, as there are evidences of continuous throttling and delay in events. This would explain the difference in cards taken at different times. Possibly the three-way cock, if used, sticks, or is improperly installed. There is no defect in valve or valve setting which will produce all the irregularities shown.

Q.—Please calculate horsepower from the inclosed cards and suggest any changes that may be desirable. H. P.

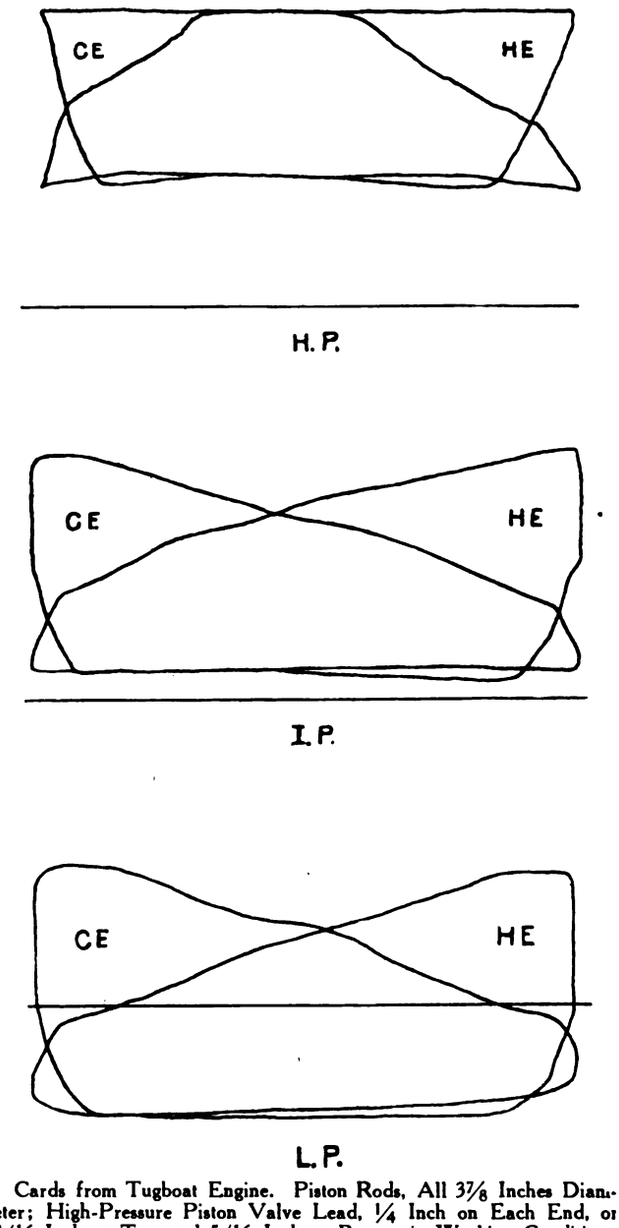
A.—The tabulation of horsepower follows, and it should be noted that the high-pressure cylinder is not doing its share of the work.

TUGBOAT ENGINE, 17", 25", 43" BY 30" STROKE. BOILER PRESSURE 190 LBS. VACUUM, 26". REVOLUTIONS PER MINUTE, 94.

Cylinder End.	Area of Card Sq. In.	Length of Card In.	Spring Lbs. per In.	M.E.P.	I. H. P. Per Card.	I. H. P. Per Cylinder.
H. P. (H E)....	3.56	3.76	80	75.7	122.2	.....
H. P. (C E)....	3.25	3.76	80	69.2	111.0	233.2
I. P. (H E).....	4.11	3.83	40	42.9	150.0	.....
I. P. (C E).....	3.74	3.81	40	39.3	134.2	284.2
L. P. (H E).....	4.40	3.79	12	13.94	144.1	.....
L. P. (C E).....	4.44	3.76	12	14.17	145.3	289.7

Total indicated horsepower, 806.7.

The intermediate-pressure and low-pressure cards are excellent and need no comment. The high-pressure card



Cards from Tugboat Engine. Piston Rods, All 3⅞ Inches Diameter; High-Pressure Piston Valve Lead, ¼ Inch on Each End, or 3/16 Inch at Top and 5/16 Inch at Bottom in Working Condition; First Receiver Pressure, 70 Pounds; Intermediate Pressure Piston Valve Lead, ⅛ Inch at Top and 3/16 Inch at Bottom; Second Receiver Pressure, 16 Pounds

gives evidence of too early admission on both ends of the cylinder and the events of cut-off and compression occur at percentages of the stroke which are more unequal than should be. The remedies for these are: First, to decrease the lead by reducing the angular advance, which would improve the heels of the cards; and, second, shorten

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the valve rod and equalize the events of stroke a small amount. If these are carefully done, and cards taken between changes to note the effect of changes and *but one thing changed at a time*, it should be possible to increase the horsepower in this cylinder by 10 percent to 20 percent, especially if the serious wire drawing into the receiver (shown by the curved back-pressure lines) could be remedied. This can be done, if the valve does not at present entirely uncover the exhaust ports, by increasing the eccentricity, which would give increased travel and therefore port-opening. The above discussion is on the assumption that the valve is direct-acting. If it is indirect, reverse the changes to conform. A direct valve is one which governs admission and cut-off by the outside laps.

Q.—Will you please explain the following regarding the question published in the January, 1915, issue, which asks for the horsepower of a sternwheel towboat driven by compound tandem condensing engines? In the answer it is stated that you doubt if such an engine as described will produce 3,700 horsepower, and you back up your statement by figures. I followed the calculations until it comes to the indicated horsepower formula, where the result given is 1,470 horsepower for one engine. I agree with all your figures except that of the area of the surface worked against. You give 3,117, which is the area of the low-pressure only. Why should not the high-pressure also be taken into consideration? If it were, we should get the following:

$$I.\ H.\ P. = \frac{2 \times 64.9 \times 12 \times (3117 + 618) \times 10}{33{,}000}.$$

I. H. P. = 1,760 for one engine, or 3,520 horsepower for two engines. J. M. E.

A.—In estimating the mean effective pressure for any multiple-expansion engine, it is customary to calculate the pressure that would be required if the work were all done in the low-pressure cylinder. This is called the mean effective pressure referred to the low-pressure cylinder and the calculation for horsepower then becomes identical with the calculation for a single-cylinder engine. For a compound engine the referred mean effective pressure is

$$M.\ E.\ P.\ (\text{referred}) = \text{low-pressure } M.\ E.\ P. + \frac{\text{high pressure } M.\ E.\ P.}{\text{ratio low pressure to high pressure}}$$

and for a triple-expansion engine

$$M.\ E.\ P.\ (\text{referred}) = \text{low-pressure } M.\ E.\ P. + \frac{\text{intermediate pressure } M.\ E.\ P.}{\text{ratio low pressure to intermediate pressure}} + \frac{\text{high pressure } M.\ E.\ P.}{\text{ratio low pressure to high pressure}}$$

The mean effective pressure used in the calculation mentioned was the referred mean effective pressure, and, therefore, already included the high-pressure mean effective pressure. The correct indicated horsepower is 1,470, as formerly given.

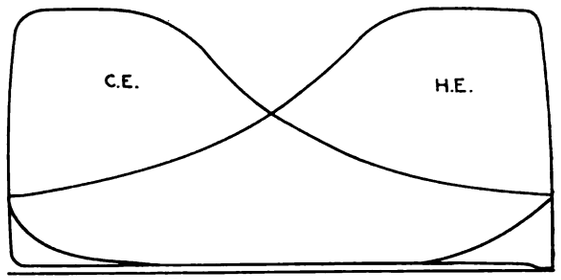
Q.—(a) I am inclosing three indicator diagrams and would like to have the exact horsepower of same calculated. These cards were taken off of one of my main engines.
(b) Why do vacuum gages read in inches instead of pounds?
(c) Why is the low-pressure cylinder of a compound engine made twice as large as the high-pressure cylinder? W.

A.—(a) The horsepower from the cards (neglecting the piston rods, as no data are given) is as follows:

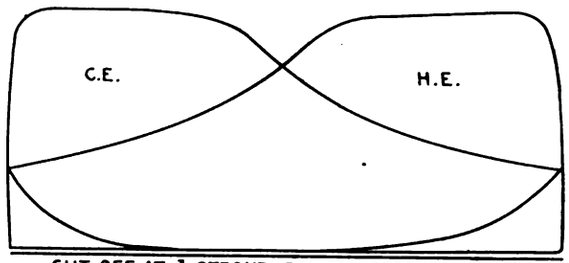
Card No.	Cut-Off	M. E. P.	I. H. P. (total)	R. P. M.
1	5/16	115 H. E. 111 C. E.	208	17
2	3/8	118.6 H. E. 117.8 C. E.	204	16
3	1/2	129 H. E. 125.4 C. E.	247	18

If they were reduced to the same revolutions per minute, say 17, the indicated horsepower from the three cards would be 208, 217 and 233, respectively, which well illustrates the effect of increasing cut-off. The cards would be improved if release occurred earlier. If the engine has a slide valve, increase the angular advance, and if poppet valves, arrange for earlier admission and release.

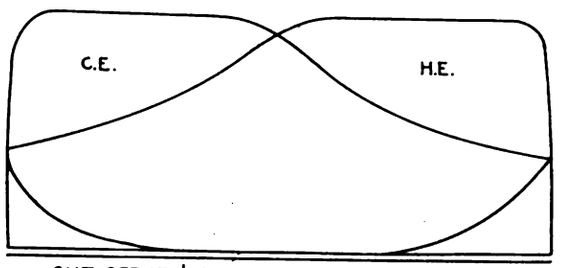
(b) By vacuum, in the commonly accepted engineering sense of the word, we mean the amount by which a pressure is less than that of the atmosphere. The pressure due to the atmosphere is measured by an instrument called a barometer, which records the height to which a column of mercury would be sucked up in a tube by a perfect vacuum, or, more correctly, the height at which the atmospheric pressure will maintain the column of mercury.



CUT-OFF AT 5/16 STROKE. BOILER PRESSURE = 190
R.P.M.=17



CUT-OFF AT 3/8 STROKE. BOILER PRESSURE = 185
R.P.M.=16



CUT-OFF AT 1/2 STROKE. BOILER PRESSURE = 191
R.P.M. = 18

Cards from Single-Cylinder Engine, 18 Inches Diameter by 84 Inches Stroke

This is not constant, but varies from day to day. All steam engineering gages always read from atmospheric pressure, as a basis or zero, and a vacuum gage reads the amount by which pressures are less than the atmospheric pressure. The barometer at the time the vacuum gage is read gives the value of a perfect vacuum in inches of mercury and the relative sufficiency of the vacuum in hand can best be determined if it reads in the same units as those common for indicating the perfect vacuum, namely: inches.

(c) One pound of steam increases in volume as the pressure on it decreases. After a certain number of pounds of steam have gone into the high-pressure cylinder up to the point of cut-off the steam expands and drives the piston before it. The steam is then exhausted into the receiver at this lower pressure and increased volume. The low-pressure cylinder, in order to take the steam and expand it still further, must be of a volume larger than the high-pressure cylinder by approximately the amount of the expansion in the high-pressure cylinder.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries — Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Insignificant Omission the Cause of Great Damage

During a recent full-power regulation trial trip with a high-powered ship fitted with watertube boilers of an approved type, explosions in four out of the total number of 16 boilers wrought terrible injury and death to a number of men, with considerable damage to several of the boilers.

The cause of this accident has been the subject of careful investigation, and it may be stated that no effort has been spared to ascertain all the facts which may have conduced in bringing about the result. So far as the investigation has extended, the primary cause, as is the cause in nearly all boiler explosions, was due to low water, or, more nearly, to a lack of water, as a result of obstructed feed.

The boilers in the ship in question are arranged in eight boiler compartments, each with two boilers. The main feed system consists of two main feed tanks, one in each engine room, four main feed pumps and two hotwell pumps, together with other feed apparatus in duplicate divided equally in the two engine rooms. There are two independent feed lines, one on each side of the ship, with proper cross-connections. The main suctions consist of 6½-inch pipes to each feed tank with branch 2-inch pipes to the reserve feed tanks. The main feed tanks are of the ordinary tank and filter type and had originally a grid-iron, float-and-lever-operated valve at the suction, which was placed at the bottom. This valve was at some time removed, the particular reason for which being not definitely known, but is supposed to have originated with the idea of obviating the possibility of accidents due to the inefficiency incident upon the operation of float valves. In this connection, it might be mentioned, that an automatically closing valve on the main feed suction in the feed tank is placed there to prevent air from entering the feed suction when for any cause the water becomes exhausted in the tank. This arrangement is, however, not used in present-day machinery installations, but instead thereof an internal pipe in the form of a gooseneck or elbow is used with the suction at the bottom or side of tank, respectively. Suffice it to say, that the float valve was taken out and a strainer put in its place. It seems the top cover of this strainer was not secured by either bolts or rivets, but held in place by some other means more or less insecure.

The investigation has divulged the following facts:

1. That the starboard feed suction line failed, due to some obstruction within the feed tanks.

2. That this obstruction was found to consist in the top of the strainer having worked loose; then it dropped to the bottom of the box and closed up the opening connecting with the suction pipe. The plate top was held down by a pressure approximately equivalent to the pressure head in the tank and suction head in the feed suction pipe, in that way effectively closing the opening.

3. The starboard tank was overflowing while the port tank was rapidly being emptied, owing to the increased demand made upon it.

4. Lack of water in the boilers was indicated by its disappearance in the gage glass of each boiler.

5. Fires were hauled on all boilers except one, and several of the boilers were pumped to steaming level with salt water.

The first explosion occurred just before the completion of the trial, successively followed by explosions in three other boilers. About 12 minutes lapsed between the first and last boiler explosion.

The pressure on the feed line ranged between 250 and 350 pounds, while the average pressure in the boilers was 170 pounds, the air pressure in the boiler rooms averaging two inches. The starboard feed tank had been overflowing during 12 to 15 minutes, showing the obstruction having lasted for about this time.

The impressions received by different observers at the time of explosions are described as follows:

The firebox doors all flew open and flame, coals and smoke came out of the doors.

While closing the blower on one boiler and walking over towards another boiler the first boiler blew up. When it blew up it was dry. There was no steam, no water, nor vapor, and just blew out a black fog of gas and dirt and flame through the center. There was no steam to amount to anything in the fireroom.

While standing between the feed pump and the throttle of the blower the explosion occurred. It blew me out into the next fireroom, the concussion was so great.

The fire doors on the boilers were not of the inswinging type but of the ordinary side-hinged outward-swinging type. Those of the doors which were shut and locked remained in that state with a few exceptions; those that were not locked blew open.

The damage done to the boilers consisted chiefly in tubes pulling out, various parts warping, and blistering and calking in drums being started.

The explosions occurred in the forward boilers, the after boilers getting the water first, being nearer the source of supply.

The damage done to the boilers, while considerable, was very insignificant compared with the injuries sustained by the men on watch, many of whom were killed and a great number severely injured.

The lesson to be drawn from this accident may be put down in these few words: No detail is too small to receive the most careful scrutiny, thought and attention. A couple of half-inch bolts in this case might have averted this accident.

EYE.

Handy Kinks for the Engineer

In removing or replacing cylinder heads or valve-chest covers, studs are often bruised so that the nuts cannot be replaced without doctoring up the threads with what the boys call "a three square file." This process is long and the delay is annoying. To get around this trouble I take a spare nut and with a round file, file inside the nut, making it into a die. Leaving the lands quite narrow, I heat this filed nut up to a low red heat and cyanide the inside, of course reheating the nut so that the cyanide

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will sink in. This produces a very serviceable die, which can be run over a bruised stud, leaving it in much better shape than if filed.

Every engine of what we now call the "old style" has certain parts of its mechanism set and then center-punched, and these marks being recorded as to their relative positions by trams; these trams often get lost or bent, with the result that very important records are entirely lost. To prevent this trouble I select some convenient surface on the engine, quite often on the engine frame, or perhaps on the upper side of the valve chest or in fact any place that can be conveniently reached and is of sufficient extent. Into this surface I drill an eighth-inch hole and plug it with a piece of brass wire and center-punch it. Then taking one of the trams, I place one of its points in this center-punch and scratch a radius on the surface selected with the other point; on this radius I drill a second hole, plugging it as before; I then scribe the arc again with the tram, and center-punch a second point in the second plug. Between these two plugs I draw a line with the scriber and stamp what the distance represents, as for instance: if the tram was for locating the position of the high-pressure valve stems, I would simply use the letters H. P. V. S.

It is quite evident that this system can be carried out easily where the trams have points of even lengths; but where they are not of even length the system has to be somewhat modified. If the difference in length of points is not great, one of the plugs can be left long enough to make up the difference; the objection to this, however, is that a peg which extends out might be accidentally bent or even carried away, so I have quite often resorted to taking a strip of steel, say five-eighths thick and of sufficient depth to make up the greatest difference in any of the tram legs and screwing the piece in a convenient position on the engine frame, or elsewhere, and center-punching its edge, working down its depth with a file or a shaper, if available, for the various length of legs of the trams.

While a ship's engine room is pretty well provided with tools and supplies, I have almost always found that during a voyage some little tinkering has to be done that draws on the tool chests of the engine-room force. The captain and all the deck officers seem to think that an engineer officer is able to make any kind of repairs from the ship's clock to the rudder stock. I have always found it extremely convenient to carry with me a small assortment of drill rods, or what they used to call "Stubbs' wire," together with drills of both body and tapping size for these rods; also a "jamb plate" or die plate for them, and taps. These wires are usually required in short lengths not over, say, three inches, and I have found that after a short time they all got mixed up in my tool chest and I could rarely find just the size that I wanted, or the tap or drill, without completely cleaning house. To overcome this difficulty I have lately bought at a drug store or chemist's, as they call it over in the Old Country—long, narrow bottles and used these to carry each size of drill rod, together with the drills and tap. It would perhaps be better if I could get metal tubes instead of glass bottles, but I have been unable to find them; yet the glass bottles have the advantage of allowing one to see what is in them without pouring the contents out.

One curious thing seems to take place with these glass bottles—they break from no apparent cause. I thought at first the breakage arose from carelessness and from being knocked about in my tool chest, but I am convinced that this is not the reason, as I have kept the bottles in places where they could not get knocked about and still the smashing continues. A brother engineer tells me that the only way to stop this breakage is to line the bottles with paper and stuff a piece of cotton in the bottom of the bottles so as to prevent the metal from coming in contact with the glass. This seems to me quite reasonable and possible, as cleaning a gage glass with anything but a stick and a hunk of waste is never allowed. I have tried putting a small round file in a gage glass and shaking it about a bit and then laying it away, only to find that in a short time the glass was in pieces.

Returning to the subject of replacing cylinder and valve-chest covers, I saw in a French-built engine a very convenient idea to assist in doing this work; it consisted of having two of the studs, which were opposite each other, made considerably longer than the other studs, but one of these two long studs was an inch longer than its mate. The thread on these long studs being turned off above the regular length of stud, thus presenting two pegs, the cylinder cover could be very easily lowered down and guided onto the longer peg or stud and then onto the second, thus bringing all the stud holes in the cover to properly register with their respective studs. When the valve-chest cover was to be handled the longer of the two studs was placed in the upper center of the valve-chest edge, while the second was directly below it, in the lower edge.

In this same French engine the packing of the cylinder heads was quite novel, at least to me. Just inside the cylinder studs there was turned a V-shaped groove and in the cylinder cover was turned a corresponding groove. A piece of thin copper tubing of proper diameter was rolled up to just drop into the groove. The joint being hard-soldered, this tube was well annealed and of sufficient diameter to allow the cover to pinch down on it. The joint, the engineer assured me, never leaked, and he used the same piece of tubing over and over again, only reannealing it from time to time. JACK.

Faulty Designing of Marine Boilers

The article on faulty designing of marine boilers by "J. S.," published in the October, 1914, issue of INTERNATIONAL MARINE ENGINEERING, was of much interest to the writer. Although much has been written about the Scotch marine boiler and vast improvements have been made in such boilers in recent years, there still remain many points for discussion. There is also ample room for various further improvements to be made. I am sure a thorough discussion by the readers of this practical journal would do much in this respect.

Referring to the remarks by "J. S." regarding a marine boiler on a coastwise tug, special attention is called to the bulging of the backs of combustion chambers, due to the 7½-inch pitch of the stays. "J. S." seems to think that this pitch is too great.

All other points being equal, the above pitch is quite in order. The writer does not believe that the fact that these stays were pitched 7½ inches apart was actually the cause of the trouble. There are other factors which would be more likely to cause some trouble or bulging, even with a much less pitch.

The writer has often wondered that there are not many more cases of boiler explosions on board tug boats, for in many cases the abuse and neglect of boilers on tug boats are criminal. Some time ago the writer had occasion to board a sea-going tug, and on going below with the chief, to the writer's surprise no water was visible in the gage

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glass, but a plug of cylinder oil stood nearly an inch above the bottom nut. The writer was informed by the chief that there was plenty of water in the boiler. He considered that as long as 2 inches of water was over the combustion-chamber top everything was all right. In fact, it was his practice to carry the water at this level, as he claimed that it gave more steam space.

As a rule, tug boats work very long hours, and the boilers are kept under steam without cleaning for long periods, with the result that often serious scaling takes place. With high steam pressures, it is not surprising to read about collapsed furnaces and distorted and bulged plates. The marvel is that the actual cases of serious accidents are so few.

In the case that "J. S." refers to, it would interest the writer to know if the fire bars were carried clear back to the back of the combustion chamber. I would also like to know the grate area, the diameter of the smoke tubes, and also the diameter and length of the boiler.

Referring to the next case cited by "J. S.," in which Howden's forced draft was used, the failure here again may not be due to defective staying, but rather from defective circulation. No doubt, "J. S." is right in his remarks in this instance, where he refers to the narrow water spaces between the back of the combustion chamber and the back of the boiler, more especially if the back of the combustion chamber is straight. When forced draft is used it is certainly bad practice to have the back of the combustion chamber dirty. The back of the combustion chamber should always have as much slope as possible to allow the globules of steam to be more readily liberated. A straight combustion-chamber back, with a restricted water space, is fatal to good circulation.

In the next case cited, where forced draft was also used, the writer is firmly of the opinion that the trouble was entirely due to overheating, due to defective circulation. The fact that in this case there was no break in the horizontal line of tubes, and the lower row of tubes was only about 4½ inches or so above the furnaces, would be quite enough to court disaster with forced draft and bad circulation. A boiler intended for forced draft calls for the most careful design and thorough attention to the minor details. The water spaces and the arrangement of tubes must have special consideration, as upon these points hang the merit of the boiler. The writer has come across cases in which boilers of equal size, that is, 8 feet by 8 feet, have had smoke tube surfaces alone varying by over 60 square feet. I have also come across cases where the bottom of the combustion chamber gave only 1½ inches clearance from the shell plate.

The writer long ago came to the conclusion that some builders never considered the question of combustion or fire grates. They seem to think this subject requires no consideration, and as long as a few fire bars are thrown into the furnace of any length that happens to be handy, it needs no further consideration. The writer has no hesitation in stating that an ill-designed and ill-proportioned fire grate and bridge can easily be made to count for a shortage of power to nearly 50 percent of the boiler's available power.

Another very common error in regard to furnace fitting where it has been found that the boilers are too small for the engines and it is desired to improve matters, the fire bars have been carried clear back to the back of the combustion chamber, with the intention of increasing the power of the boiler from the additional grate area. It would interest the writer very much to hear of a case where this method has been a thorough success. Personally, he has not seen one yet, but, on the contrary, he has seen good boilers practically ruined by the adoption of this plan.

There is a limit to the power which can be generated in any boiler, and when, through an error in design, or through an attempt at false economy, a boiler much too small, even when worked at its maximum power, is supplied, nothing can be expected but trouble and expense. In fact, it is not an uncommon sight to see such a boiler with the funnel practically at a red heat, the color of which is easily visible at night. All of which proves that the combustion chamber has been transferred to the funnel, which can hardly be called a proper place for the production of steam.

There is no advantage to be gained by a large fire grate if the right proportion of smoke tubes is not provided to carry off the gases. In some cases too large a fire grate has caused explosions in the back of the furnace, which have blown the fire through the doors when the stokers have opened the doors for firing. Such conditions mean low efficiency and heavy boiler repair bills.

The writer is quite in accord with "J. S." in the matter of the proper position of fire bars and bridges. There is far more in this matter than some builders seem to imagine. As "J. S." says: "Where a boiler fails to supply the required amount of steam on a trial trip, assuming other proportions correct, in many cases all that is required is a reconstruction of the fire bars and bridges." As a proof of this, the writer had an experience some time ago with a marine boiler supplying steam to a stationary plant. Great trouble was experienced in keeping up steam; in general, the conditions were bad. The fire bars had been run clear back to the back of the combustion chamber, the grate area being 37.5 square feet. After reconstructing the fire bars, and fitting proper bridges, the writer reduced the grate area down to 20 square feet, after which the boiler steamed well, and gave excellent results. No shortage of steam has been experienced since then, and a saving of nearly one ton of coal per week has resulted from this alteration. This is only one of many cases which the writer has handled in the same manner with very great advantage and economy and compares with the practical remarks of "J. S."

As regards the matter of steam space, it is always false economy to curtail boiler dimensions. If any error is made the dimensions should be too large rather than too small. From .58 to .65 cubic feet per indicated horsepower should give fairly satisfactory results, other proportions being equal. There is no doubt but that the main trouble occasioned in marine boilers is due to the fact that the boilers are too small for the engines for which they are to supply steam. Exhausted stokers, who have spent every ounce of their energy in a mad effort to keep up steam, will bear witness to the truth of this statement, and I have no doubt that it is well known to "J. S."

No doubt, many failures of boilers to supply sufficient steam, where the boiler proportions are good, exists in the fact that the coal supplied is of a cheap quality and of low calorific value. If a designer has figured on a certain consumption of fuel per square foot of grate, and assumed that feed water is delivered to the boiler at a high temperature, knowing the rate of evaporation from an average steam coal, the builder is quite justified in rating the power of his boiler on this assumption. Inferior coal and other defects, however, may bring the power of the boiler considerably below the builder's rating. Take a marine boiler with 40 square feet of grate area. The designer knows from past experience that under ordinary conditions 18 pounds of good steam coal can be burned

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per square foot of grate area, or 750 pounds per hour, and that 10 pounds of water can be evaporated from and at 212 degrees Fahrenheit per pound of coal, making 7,200 pounds of water. Assuming a compound engine, using 20 pounds of steam per horsepower, the boiler should supply steam for 360 indicated horsepower.

On the other hand, it is more often the case that a cheap coal of low calorific value is supplied, only 12 pounds of which can be burned per square foot of grate, and only 7 pounds of water can be evaporated per pound of coal. We, therefore, have 480 pounds of coal consumed and an evaporation of 3,360 pounds, supplying steam for only 168 horsepower, which is a very different state of affairs. Should the boiler be too small and require additional forcing to get the required power, the case will be practically hopeless.

Another cause of many boiler failures is that the designer has little or no say in the matter, and is thereby compelled to depart from what he knows by experience to be right. He is often supplied with the main particulars as to length and diameter, and diameter of furnaces. In some cases the heating surface is given, but in many cases it is not, and very often the designer is informed that the particulars given are binding and must be adhered to. Beyond this, he may hear nothing further until some few months later, when he may be asked to look up particulars regarding boiler No. so-and-so, as complaints have been received from the owners that the boiler is too small and does not give satisfaction. When the matter is finally investigated, it is found that the boiler would have been satisfactory if it had been 1 foot larger in diameter than the one ordered. The results, therefore, are due entirely to the owners or their representatives.

In conclusion, the price of coal has advanced so much in recent years that owners cannot, or at least think they cannot, afford to pay the price asked for good steam coal, with the result that the cheap, inferior coal is the order of the day, and many boiler failures follow as regards steaming capacity.

Some time ago it was the writer's privilege to see the Ross Schofield circulators fitted, with very satisfactory results, to a marine boiler that was very much too small for its service. Perhaps the following figures may be of interest to some of the readers of this journal.

For the four months previous to fitting the circulators the coal consumption was 144 tons. For the four months after fitting the circulators the coal consumption was 123 tons. During the four months before the circulators were fitted the vessel ran 3,848 miles, while for the four months after the circulators were fitted the mileage was 4,720, or 872 miles more on 20 tons less coal. Of course, the extra mileage is not due to the circulators, but the duty of the boat was that much more and accomplished on 20 tons less coal.

Gloucester, England. C. R. WILLIAMSON.

Instructions for Firing

Each fireman will usually declare that he is spreading his coal evenly over the fires and that there is nothing left to be desired in his way of firing. He has a peculiar twist, that he gives to each shovelful, which causes the coal to spread out into a nice even layer. He can't say just how it happens; but he does it just the same. Such is human nature when one is dealing with himself. The facts are entirely different.

After watching supposedly first-class firemen working, and after carefully examining the fires built up by them, it was easily seen that the coal was not spread evenly but that it was piled in roughly, leaving hills and hollows in the bed of burning coal. All the leveling was done with either the hoe or the devil's claw.

In order that each man might see exactly what he was accomplishing, a dummy furnace was built out of rough timber. The fire space was represented by a wooden box: the bottom representing the grate; the top, the lower rows of tubes; the sides, the firebrick walls of the furnace. The front end of the box was closed and a door (similar to a regular furnace door) provided; the back end of the box was left entirely open. The whole box was so placed in an unused fireroom that it was at the same height as one of the furnaces would be under actual conditions of firing.

Each fireman was given a chance to show his skill with this contrivance. A pile of coal was placed near the furnace door. At a signal from the instructor the fireman threw open the furnace door, rapidly shoveled the coal in (using his own individual method), then swung the door shut, the whole just as though he were firing under the most approved system. He then confidently walked around to the back of the box to see what results he had obtained in spreading the coal evenly.

The results were a surprise in nearly every case. A strong fireman usually caused at least one-half of his coal to go clear through the dummy furnace and to land on the floor plates beyond. In actual firing such work would cause about one-half of the coal used to bank up against the back wall of the furnace, where it is quite probable that it would remain, as few firemen reach in that far with a hoe. Others made a neat little pile in the center of the box bottom; a performance that would be sure to cause much smoke and loss of heat in actual practice. There were many more peculiarities, but the principal result was to show that proper firing was almost unknown in that fireroom.

The discovery of this unpleasant fact led to continued practice by all firemen in the department. If a man desired to hold his rate he had to show that he could really do his work on the fires. The results were not instantaneous, but they told in the end. Less smoke, less coal, more steady steam, and less actual work in firing were some of the results achieved by improving the fires.

In addition to working the firemen at the dummy furnace, coal passers were given a chance to partly qualify for firemen by the same means. This resulted in a new fireman actually knowing how to spread coal when he first got his rate and pay of a fireman.

Although allowances must be made for the fact that conditions in regard to heat, etc., were not the same when conducting dummy practice as they were when actually firing a steaming boiler, the results achieved fully repaid all time and money spent on the dummy furnace. If one can do a thing well under favorable conditions, he is better qualified to do it under unfavorable conditions than if he has never attempted it at all. This is the foundation upon which all such training must rest.

W. W. B.

RIVER TERMINAL CONFERENCE.—A conference on River Terminals of Mississippi Valley States was held in St. Louis, Mo., on February 18 and 19. Reports were presented by delegates from those cities along the rivers in the Mississippi Valley that have made substantial progress in improving river terminals, and papers were read by prominent engineers and city officials identified with the work of providing adequate river terminal facilities. The relation of the Panama Canal to the Mississippi Valley was discussed, and the new terminals at New Orleans, St. Louis, Kansas City and other large cities described.

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Marine Articles in the Engineering Press

Some Recent Developments in Marine Engines and Auxiliaries—A Discussion of the Use of Gusset Plates in Ship Construction

Recent Development of Marine Engines, Including Propulsion.—This review deals with the experience in marine engineering of the last 10 to 15 years. Starting with a consideration of the Scotch boiler, it acknowledges its great economic superiority, particularly with high pressures up to 235 pounds and the Howden type hot forced draft. It records modern requirements of boiler material tests and protests against English Board of Trade test pressure at double the working pressure. The article takes careful note of the modern superheated steam plant with its saving in coal. The watertube boiler is dealt with, giving German naval experience with one single type of bent-tube form and mercantile experience with a straight-tube type, usually in connection with steam turbines. The turbine is considered firmly established upon ships of over 20 knots speed. Difficulties of propeller revolutions and of structural turbine details are said to be more readily overcome. The modern tendency of adopting combination turbines of several impulse wheels in the high-pressure range with low-pressure reaction drums is quoted, as well as the mixed system for medium-speed ships of two piston engines exhausting into one low-pressure turbine. The growing popularity of the hydraulic transformer, as well as gear transmission, is commented upon. The oil engine receives considerable attention, pointing out that the difficulties experienced so far can be readily overcome, many being only in the auxiliaries, while cracked engine parts might, in the exposed parts, be exchangeable; lubrication difficulties could be overcome by larger bearings, better quality of oil and forced feed. The requirements of power by the auxiliaries are discussed, as well as the suitability of sea water for cooling purposes. It is noted that a great many complaints of ship owners against the oil engine are still recorded, as must be expected for a new type, which, however, is likely to be simplified and improved. A table of data of the leading recent marine oil engines is given. In conclusion, a plea is made for efforts to minimize coal-bunker trimming and the labor on sea-going vessels by installing suitable efficient machinery. 2 tables. 5,300 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* August 1.

Recent Auxiliaries and Equipment for Merchant Vessels.—This article is a continuation of one previously reviewed giving a description of modern electric and steam winches for different purposes, among them being a 24 horsepower electric combined provision, coal or boat hoisting winch, as now frequently installed upon large passenger steamers. A description is also given of a 24 horsepower electric boat hoister, a steam fish net winch with a drum capacity for 700 fathoms, and a steam boat hoister, also with nigger heads only. Mention is made of the sounding machines which are now put on the market fitted with a 2½ horsepower motor, and which allows a 55-pound lead to be heaved at a rate of over 7 feet per second. Among the equipment is described the Clayton apparatus, which generates and employs sulphur-dioxide for purposes of fire extinction, disinfection and vermin extermination: further are mentioned the fire extinction systems, which employ carbonic acid gas and the automatic Grinnell sprinklers. Among the modern auxiliaries for the engine room are noted the Weir dual air pump and a twin steam ash hoist of the drum type. Further, an evaporator of the double effect type is well described, as well as a feed heater. Attention is given to modern ball and roller thrust bearings, describing two different types, both conveniently arranged in adjustable casings with oil retention. In conclusion, mention is made of the new Brouguiere marine governor, which under pitching motions of the ship opens or closes a special stop valve through the inertia action of a heavy weight, being so jointed, however, to the valve lever that rolling motions have no effect upon the valve. 45 illustrations. 2,900 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* September 12 and 19.

On the Use of Plate Gussets in Shipbuilding.—This article deals with the question of whether or not gusset plates are always employed to the best advantage in ship construction. It endeavors to show that they are best employed for two cases, first when the member to be connected can be held rigidly and clamped, and second in the skeleton framing of the ship. The importance of the support of the gusset upon the rigidity or elasticity of the member is pointed out and the claim made that in many cases the gussets are only extra weight and that a simple corner angle would have done as well, treating the girder only as loosely supported. The author thinks that even the limited rivet area obtained by the latter will be satisfactory for most cases. The demand of the classification societies for gussets nearly everywhere is criticised as wasteful in the direction of weight and cost; this applies principally to gussets on watertight bulkheads. According to the deductions of the author there are two places in the ship where plate gussets are unnecessary, namely, at the half beams abreast of hatches and at the beams of the superstructure houses and decks. For the first he considers it desirable to put more strength and rigidity into the frame section at the ends of the hatch and for the latter he sees a better stiffening to be obtained from wide-spaced belt frames and beams. 3 illustrations. 2,700 words.—*Schiffbau,* December 9.

Progressive Speed Trials of Motor Boats.—By A. H. Burnand. A description of a method of making speed and power trials by motor boats by making use of data from bench tests of the motor under various conditions of speed and power, and then determining the brake horsepower of the motor on actual speed trials of the boat by measuring accurately the revolutions per minute and interpolating from the power curves obtained on bench tests. By a combination of the data thus obtained a curve of horsepowers at various speeds of the boat may be plotted. 2 illustrations. 1,300 words.—*Engineering.* November 20.

Experimental Marine-Type Engine at the South Shields Marine School.—Plans and description of a vertical open-front, four-cylinder, quadruple expansion marine steam engine supplied to the Marine School, South Shields, by Messrs. W. Sisson & Co., Ltd., engineers, Gloucester. The cylinders are 6 inches, 8½ inches, 12 inches and 16½ inches in diameter with a stroke of 12 inches. The engine is designed to take steam from the boiler at 200 pounds per square inch, and when working quadruple expansion and running at about 150 revolutions per minute the output is 60 brake horsepower. The engine will be used for experimental tests and investigations. 11 illustrations. 1,250 words.—*Engineering,* November 20.

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ENGINEERING SPECIALTIES

Durable Wharf Buildings

Wharf buildings situated at tidewater demand unusually durable materials, due to the fact that they are exposed to the action of salt air and mist in addition to the ordinary action of the elements. Galvanized sheet metal would appear to be one of the most suitable materials for this construction, if it were not for the fact that galvanizing is a protection only so long as it lasts, and that at tidewater zinc galvanizing is very far from permanent, corroding away in the course of a very few years and leaving the base metal exposed to the active forces of disintegration.

Municipal Wharf, San Diego, Cal. Dimensions, 70 x 760 Feet. Roofing, No. 14 Gage Galvanized 2½ Inches Corrugated Armco; Siding, No. 22 Gage Galvanized 2½ Inches Corrugated Armco

It has been found, however, that the main cause of the rapid deterioration of modern steel is its high content of impurities, especially manganese and sulphur. It is generally agreed that if these and other impurities could be entirely eliminated an iron would be produced which would be practically rust-proof. This, of course, is impossible in practice, but a number of the leading sheet-metal manufacturers of this country are now producing iron of a very high purity, the total content of all the substances considered impurities being reduced to a very small fraction of 1 percent. While more expensive than ordinary bessemer or open-hearth steel, experience seems to justify its extensive use. A number of the largest wharf and accessory buildings completed within the past two years have been covered with "Armco" iron, made by the American Rolling Mills Company, Middletown, Ohio, which comes under the high grade of material above referred to. The illustration shows municipal pier A at Los Angeles harbor, in the construction of which "Armco" iron was extensively used.

Kreutzberg Volumetric and Velocity Meter

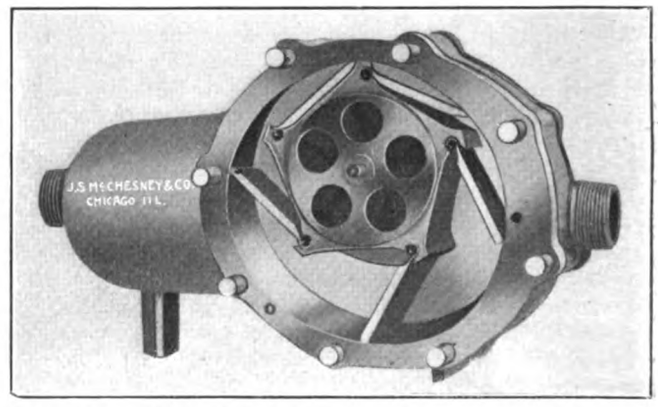
J. S. McChesney & Co., Chicago, Ill., has placed on the market a meter, known as the Kreutzberg meter, which is designed to measure accurately the volume and velocity of any fluids passing through it. The meter consists of a casing in which a drum fitted with hinged vanes is mounted eccentrically. As the drum rotates a certain definite volume of the fluid passing through the meter is confined between two adjacent vanes, and in this way the fluid is mechanically divided into sections of definite volume, so that the number of revolutions of the drum, recorded on a register, gives by direct readings the amount and velocity of the flow of the fluid.

The fluid enters the meter through a screened chamber, so that any solid matter will be removed. The fluid then passes into the meter and impinges against the vanes, causing the drum to rotate. When a vane passes the cut-off point on the inlet a section of fixed volume of the fluid is contained between the cut-off vane and the next vane ahead. The fluid is discharged as the vane passes the outlet opening at the opposite side of the meter.

It is claimed that the Kreutzberg meter makes possible the rapid and accurate measurement of commercial quantities of any fluid, such as oil, alcohol, turpentine, etc., and also gas, steam and air under high pressure. Since the function of the vanes is to divide the flow into sections, the pressure on each side is theoretically the same, and in practice differs only by the energy required to rotate the drum which in pressures greater than five pounds is negligible. The wear on the vanes is at the end, and this, it is claimed, is automatically taken up.

With compressed air and pneumatic tools in general use, the loss of air, whether through faulty tools or by line leakage, frequently assumes serious proportions. To detect this loss and accurately measure the amount of air required to secure maximum efficiency, the Kreutzberg meter has been found most useful, especially to the user of pneumatic tools seeking absolute information as to air consumption in the shop or the efficiency of tools offered for sale.

It is stated by the manufacturers that several railroads and factories are using the meter in compressed air and steam lines to determine proportions of total supply delivered to different departments, thus affording figures upon which to base operative and manufacturing costs. Comparative tests are also made as to the air consumption of a tool when new and after a period of service. In this latter case, if the consumption has increased excessively, the tool may be subject to inspection to determine where the leakage occurs and how this can be reduced so that the tool will regain its original efficiency for a longer period. Further, tools may be tested periodically and sent to the tool room for repair when excessive air consumption is required to work them at full efficiency.



Kreutzberg Meter with Side Removed, Showing Drum and Vanes

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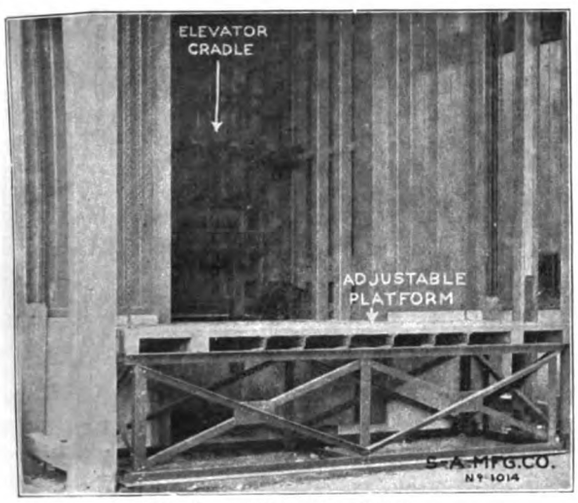
Wool Bale Elevators of the Sidney Harbour Trust

The Sydney Harbour Trust, of Sydney, Australia, has recently made a duplicate installation of elevating machinery for handling wool bales. These elevators are of the continuous type especially designed for the service and replace old hydraulic lift elevators. Since operating the new elevators it has been found that the cost of handling the wool bales has been greatly reduced, because the continuous elevators avoid the rehandling which was formerly necessary in stacking the bales on the platform of the old lift.



Cradle and Receiving Platform

The bales are delivered from larries onto the receiving platforms of the elevators. These platforms are made adjustable so that they may always be held at the level of the stacks, being lowered as the stack is reduced. The elevators are made sufficiently wide to take the bales lying down, making it unnecessary to turn the bales up on end before delivering to the cradles. At the discharge end the elevators are provided with special guides which automatically turn the bales into correct position for trucking.

The cradles of the elevators are made up of "T" steel fingers which dovetail with similar fingers on the loading platform. The cradles are supported on special attachments carried on two strands of "S-A" combination chain. Individual motor drives are provided for each elevator, driving through silent chain and two sets of reduction gears. Automatic brakes are also provided to prevent the elevators reversing when power is suddenly shut off.

The elevators are approximately 48 feet centers and at their operating speed of 60 feet per minute are capable of elevating 280 500-pound bales per hour.

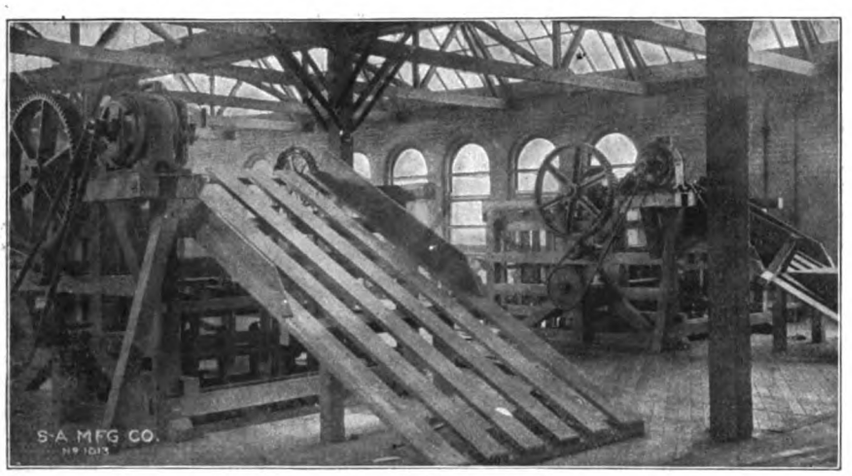
These elevators were designed by the Sydney Harbour Trust, under the direction of Mr. W. F. Adams, assistant engineer, and J. H. Groom, chief draftsman. They were manufactured by the Stephens-Adamson Manufacturing Company, of Aurora, Ill.

The New Wilson Safety Goggle

In the May, 1914, issue of INTERNATIONAL MARINE ENGINEERING was published an illustrated description of the Willson safety glasses, manufactured by T. A. Willson & Co., Inc., Reading, Pa., for protecting the eyes of chippers and men doing heavy work where they are liable to be struck by large slugs of metal. These glasses, it will be recalled, are of an extra strong construction, having a patented safety flange which extends ⅛ inch over the back of the glass to prevent broken glass going through and injuring the workman's eye. The side shields are made of strong wire screen. The temples are inside the shields and fold back of the glass.

Such heavy protection glasses, however, are unsatisfactory for grinders, machinists and men doing light work, so a short time ago the manufacturers perfected a new Willson goggle especially designed to meet the requirements of grinders and machinists. The new goggle is very light in weight and at the same time substantial enough to withstand the hardest knocks to which it would be likely to be subjected. The safety flange used in the previous heavy chippers' glasses has been eliminated, as there is no danger of the glass being broken. Protection is only necessary from flying bits of emery, dust and grit. The rim of the new goggle which replaces the flanged frame of the safety glass is amply strong. The lenses are of good quality glass. The side shields are much lighter and of finer mesh. The temples are on the outside of the shields and fold over the front of the glasses. The new goggles are supplied in a strong steel case, protecting them when carried by the men.

The manufacturers of the above specialties were awarded the grand prize at the Second International Exposition of Safety and Sanitation, held at the Grand Central Palace, New York, December 12 to 19, 1914, in acknowledgment of the merits of the Willson safety glass, the new Willson goggle and the Albex eye protector.



Discharge End of Wool Bale Elevator

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Buffalo Machine Guards

The Buffalo Wire Works Company, Buffalo, N. Y., has on the market wire machine guards to be placed around exposed moving parts of machinery, such as belts, flywheels, pulleys, etc. The guards are made to fit almost any

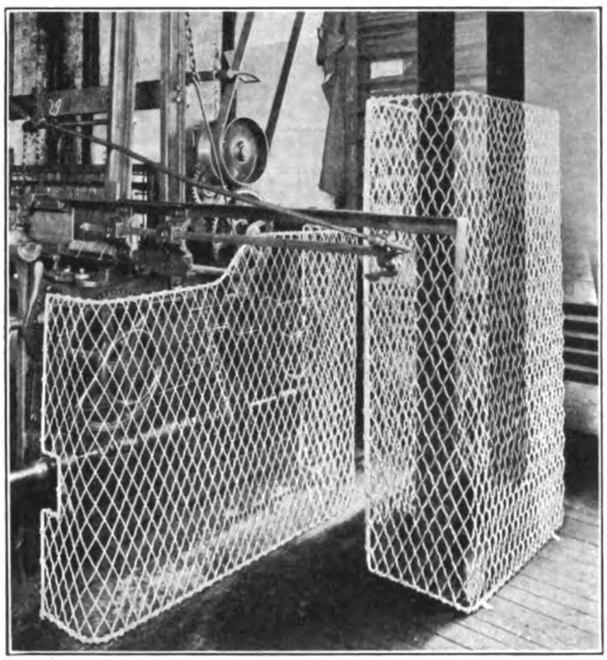


Fig. 1

arrangement of machinery. They are constructed with 1½-inch diamond mesh of No. 9, 10 or 12 gage wire with either channel iron frames (as shown in Fig. 2) or round iron frames (as shown in Fig. 1). Means are provided

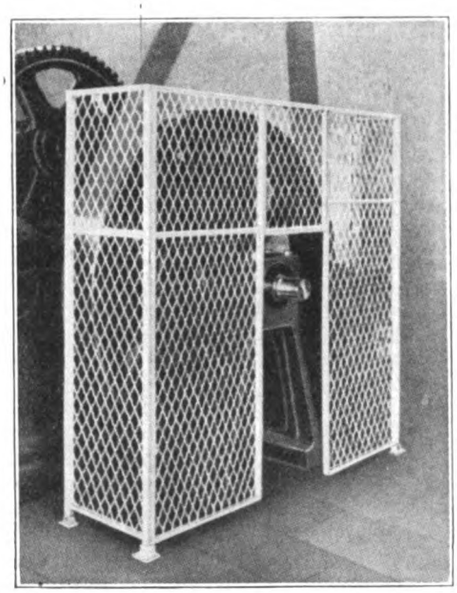


Fig. 2

for fastening the guards to the floor, or either type can be made with legs that can be fitted into holes in the floor and thereby allow the guards to be removed when necessary.

Machine guards of this type are one of the most important safety appliances that can be installed in a shop. They not only save life and limb, but also decrease insurance rates and the costs for damages from accidents.

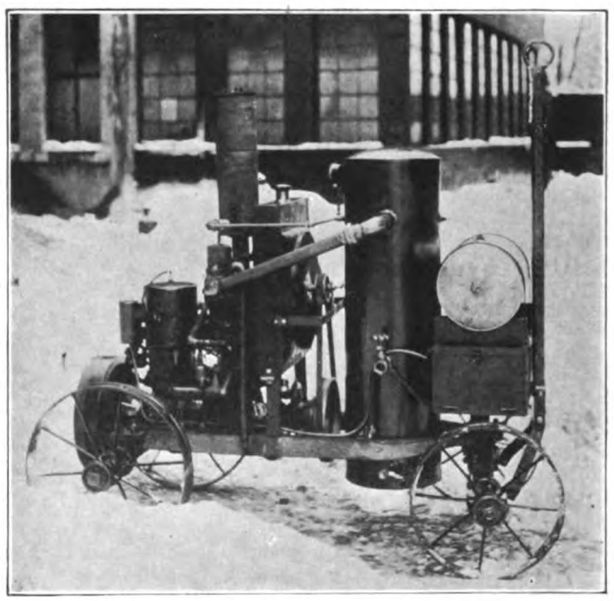
Worth Brothers-Coatesville Rolling Mill Company to Manufacture Basic Open Hearth Steel Tubes

The Worth Brothers-Coatesville Rolling Mill Company, Coatesville, Pa., which holds the unique position of being the only tube manufacturer that can supply itself with basic open hearth steel skelp for tube manufacture, has decided to take advantage of this opportunity to manufacture basic open hearth steel tubes. The value of Worth Brothers' well-known quality of locomotive boiler and firebox steel for equipment and repairs is well recognized throughout the United States. This same quality, it is claimed, will be used in making basic open hearth steel tubes.

The Coatesville Rolling Mill Company claims that for many years it has been the largest producer of charcoal iron boiler tubes, and that it will continue to maintain this position, at the same time having the distinction of being the only tube manufacturer that can supply the trade with both charcoal iron and basic open hearth steel tubes manufactured from the ore to the finished product.

A Small, Portable Air Compressor

The small gasoline (petrol) engine driven portable air compressor illustrated has been developed by the Ingersoll-Rand Company, New York, to meet the needs of the contractor doing work of a temporary character requiring compressed air in small quantities. The compressor



Gasoline-Driven Portable Air Compressor

is operated by a simple single-cylinder gasoline (petrol) engine, which is coupled directly to the compressor, both pistons working on the same crank shaft. The engine is of the single-acting, two-cycle type, closely following the well-known marine designs. The air compressor, which is one of the company's standard types known as "Imperial XII," has a capacity of 45 cubic feet per minute at

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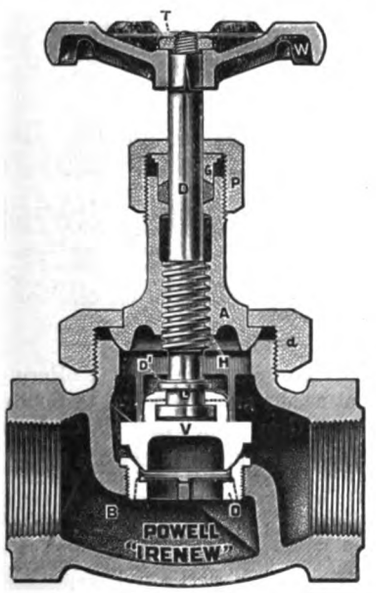
a pressure of 90 pounds. It is fitted with an air unloader and the engine with a centrifugal governor. Cooling is provided for by a gear-driven pump and an automobile type radiator, with large tank capacity, serving both the compressor and engine. The radiator is assisted by a large fan.

The frame, axles and wheels are of steel, the front axle is arranged with swivel connection to the frame, permitting horizontal rotation for turning corners and sufficient vertical movement to accommodate the wheels to inequalities of the road without strain on the frame. An air receiver tested to 300 pounds water pressure and fitted with safety valve, pressure gage, necessary piping, outlets, etc., is hung at one end of the frame, and a gasoline (petrol) tank of 15 gallons capacity is supported on a large tool box, as shown in the illustration. The outfit complete weighs 1,600 pounds and is designed for hand transportation, but can be fitted with tongue and single tree if desired.

New Powell "Irenew" Valve

The William Powell Company, Cincinnati, Ohio, has placed on the market a new iron body bronze-mounted valve made in sizes of ¼ to 2 inches, inclusive, with screwed ends suitable for 150 pounds working steam pressure. The body is of cast iron with four guide ribs cast in the neck extending down close to the seat for a true axial guide to the disk while opening or closing the valve. The valve seat ring is cast of white "Powellium" bronze, a non-corrosive metal applicable to most tem-



pertaures of superheated steam, or cyanide solutions. Whenever a renewal is necessary, it is simply necessary to unscrew the seat ring by means of a flat tool of any kind engaging the lugs projecting from the inner circle. The valve disk is of the renewable horseshoe type arranged to slide over the head of the stem into a socket, permitting it to swivel freely. It is cast of white "Powellium" bronze, making it practically indestructible. For regrinding, it is simply necessary to release the bonnet by unscrewing the hexagonal end, withdraw the valve trimming and insert a pin or nail of suitable size through a drill hole to lock the disk. Fine sand or brick dust, ground glass and soap water is then applied to the disk, and it is rotated back and forth on the seat ring until a good bearing is obtained. The valves are made in globe, angle, cross and check valve patterns with screwed ends.

Personal

Arthur Simpson has been made chief engineer of the ferryboat *City of Cairo,* at Paducah, Ky.

Joseph Cody, of New Orleans, La., has been appointed third assistant engineer on the tank steamer *Alabama.*

Thomas J. Holmes, of New Orleans, La., has succeeded Charles Cornelius as assistant engineer of the steamer *Josh Cook.*

Ed. Latham has been appointed chief engineer of the river steamer *St. Louis,* Paducah, Ky., which will take up the St. Louis and Tennessee river trade about March 15.

Ward Sadler, formerly of the Johnson Iron Works, New Orleans, La., has accepted the position of chief engineer of the tank steamer *Montana.* A. O. Mildey is his first assistant.

Frank J. Sedivy is chief engineer of the Paducah & Cairo daily packet steamer *Rapids,* which has just resumed her regular trade after being laid up for several weeks on account of high water.

J. A. Narroway, formerly second engineer of the river steamer *Barrett,* is now second engineer of the river steamer *Gleaner,* which recently left Paducah, Ky., for the south with a large tow of coal.

George Murrel has been appointed chief engineer of the river packet *Alma,* which left Mobile, Ala., February 17 for Bigbee River points. H. M. Mallory is assistant engineer of this vessel.

Harry J. Thompson has resigned the position of chief engineer of the Associated Bar Pilots' tugs, New Orleans, La., to take up the furnace building business carried on for the past twenty years by the late Maurice Waller.

Anton A. Raven has retired as president of the Atlantic Mutual Insurance Company, New York, becoming chairman of its board of trustees. Mr. Raven has been connected with the Atlantic Mutual Company for sixty-three years, and was elected its president in 1897. Mr. Raven's successor is Cornelius Eldert, formerly vice-president. Walter Wood Parsons, heretofore second vice-president, has been elected vice-president, and Charles E. Fay, who was third vice-president, becomes second vice-president.

Obituary

H. Ward Leonard, inventor of the Ward Leonard system of electric drive, died of apoplexy in New York on February 18, aged 54.

Ellery S. Allen, for more than fifty years continuously employed in the coastwise steamship service, as agent and manager, died at his home in New York city on January 31, aged 78. For most of his business life Mr. Allen was connected with the Cromwell Line, operating between New Orleans and New York, which was absorbed in 1902 by the Southern Pacific Company. Mr. Allen retired from active business in 1907.

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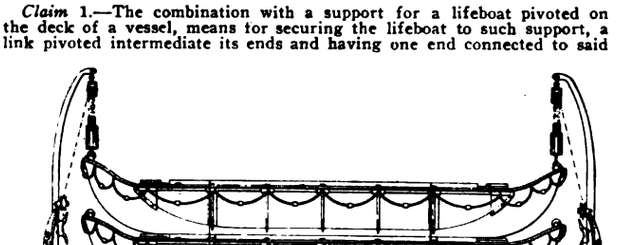
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

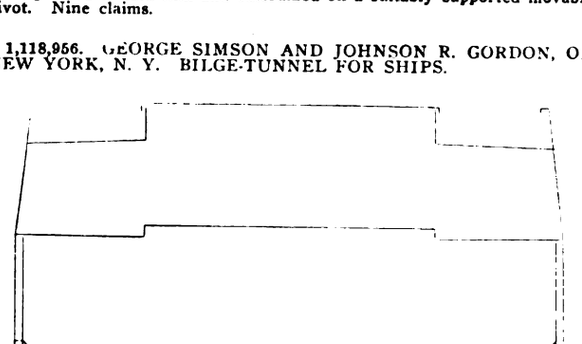
1,118,527. DEVICE FOR SECURING AND RELEASING LIFE-BOATS. HARRY W. BROADY, OF BAYSIDE, N. Y., ASSIGNOR TO WELIN MARINE EQUIPMENT COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—The combination with a support for a lifeboat pivoted on the deck of a vessel, means for securing the lifeboat to such support, a link pivoted intermediate its ends and having one end connected to said



pivotal support and means for rocking said link, comprising an actuating lever pivoted to said link and fulcrumed on a suitably supported movable pivot. Nine claims.

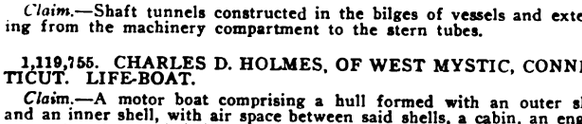
1,118,956. GEORGE SIMSON AND JOHNSON R. GORDON, OF NEW YORK, N. Y. BILGE-TUNNEL FOR SHIPS.



Claim.—Shaft tunnels constructed in the bilges of vessels and extending from the machinery compartment to the stern tubes.

1,119,755. CHARLES D. HOLMES, OF WEST MYSTIC, CONNECTICUT. LIFE-BOAT.

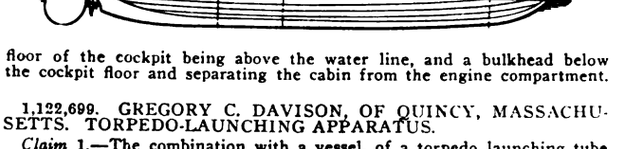
Claim.—A motor boat comprising a hull formed with an outer shell and an inner shell, with air space between said shells, a cabin, an engine compartment, a cockpit between said cabin and engine compartment, the



floor of the cockpit being above the water line, and a bulkhead below the cockpit floor and separating the cabin from the engine compartment.

1,122,699. GREGORY C. DAVISON, OF QUINCY, MASSACHUSETTS. TORPEDO-LAUNCHING APPARATUS.

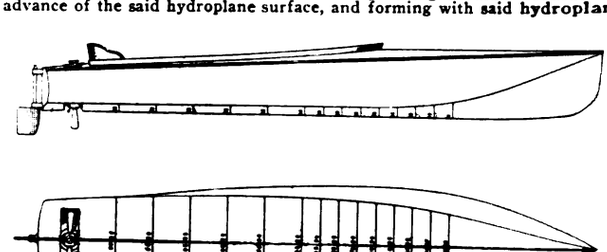
Claim 1.—The combination with a vessel, of a torpedo launching tube mounted to discharge its torpedo transversely of the direction of move-



ment of the vessel and below the surface of the water, said launching tube being free to move angularly with the torpedo during such discharge and being normally uninfluenced by the movement of the vessel through the water, whereby as the torpedo issues into the water its tendency to bind in the muzzle of the launching tube is met and suppressed by an accompanying angular movement of the tube. Six claims.

1,121,006. WILLIAM H. FAUBER, OF CHICAGO, ILLINOIS. HYDROPLANE-BOAT.

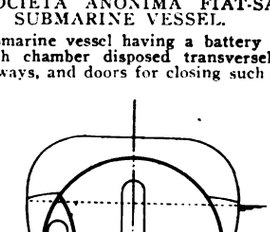
Claim 1.—A hydroplane-boat provided at each side of the center line of its bottom with a hydroplane surface which is inclined from the side wall of the hull downwardly and inwardly toward the said center or keel line, and with a transverse, rearwardly facing shoulder located in advance of the said hydroplane surface, and forming with said hydroplane



surface a transversely extending air space or channel, and also provided on the submerged parts of the sides of its hull with longitudinally continuous surfaces adapted to prevent the escape of air from the said air spaces or channels and air forcing means acting to deliver air under pressure to said air spaces or channels and adapted therein to maintain bodies of air under a pressure not less than the pressure exerted by the water against said bodies of air. Sixteen claims.

1,120,392. CESARE LAURENTI, OF SPEZIA, ITALY, ASSIGNOR TO SOCIETA ANONIMA FIAT-SAN GEORGIO, OF SPEZIA, ITALY. SUBMARINE VESSEL.

Claim 1.—A submarine vessel having a battery chamber, there being end walls for such chamber disposed transversely of the vessel and provided with doorways, and doors for closing such doorways, and a parti-



tion disposed at one side of such chamber and extending from one end wall to the other and spaced from the side of the vessel for forming a gangway laterally of the said chamber for affording communication between the portions of the vessel disposed forwardly and rearwardly of the said chamber. Two claims.

1,121,116. CHARLES A. MORRILL, OF PORTSMOUTH, NEW HAMPSHIRE. LIFE-BOAT-LAUNCHING APPARATUS.

Claim 1.—Life-boat launching-apparatus comprising in combination pivoted davits, a swinging platform hingedly attached to the ship's deck, and means connecting said platform to said davits, said platform being arranged to form a lateral extension of the deck when the boat is in loading position. Five claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

14,402/1913. IMPROVEMENTS IN MEANS FOR CLOSING AND LOCKING PORT HOLES. W. GILBERT, OF CAMBRIDGE.

According to the invention to operate or control the operation of one or a plurality of port holes from a distant point, an auxiliary link or member is connected at one end to the hand lever or to a bell cranked extension, and engaged at the other end with a controlling rod. When the controlling rod is being moved to its locking position, the respective stops engage and operate the respective auxiliary links of any port holes which are open, so as to cause the closures to be shut and locked by turning the carriers on their hinge pins, and by turning the locking rings on their carriers and remain in engagement until the controlling rod is returned to neutral position, without moving the auxiliary links of any shut port holes.

19,743/1913. APPARATUS FOR CONTROLLING FROM A DISTANCE AND FOR REGULATING THE SPEED OF THE PROPELLING TURBINES OF A SHIP. SOC. ANON. ITALIANA GIO ANSALDO & CO. OF GENOA, ITALY.

This invention comprises broadly an apparatus for controlling from a distance and for regulating automatically the propelling turbines of a ship, in which the valves both of the ahead and of the astern turbine are operated by the shaft of a differential gear one of the loose elements of which is connected to and driven by the propeller shaft, on which are mounted the turbines, whilst the other is connected to and driven by the shaft of a regulating motor, the speed of which may be caused to vary in the two directions of rotation and within wide limits, starting from zero so that the shaft of the differential gear remains at a standstill, and the valves keep up their position as long as the speed of the turbines is exactly maintained at the ratio established with the speed of the regulating motor, whilst the shaft turns in such a direction as to widen or to restrict the opening of the valves according to whether the speed of the turbines is slower or faster than that which corresponds to the speed of the regulating motor.

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